Westinghouse Structural Steel Applications in the AP1000® Plant

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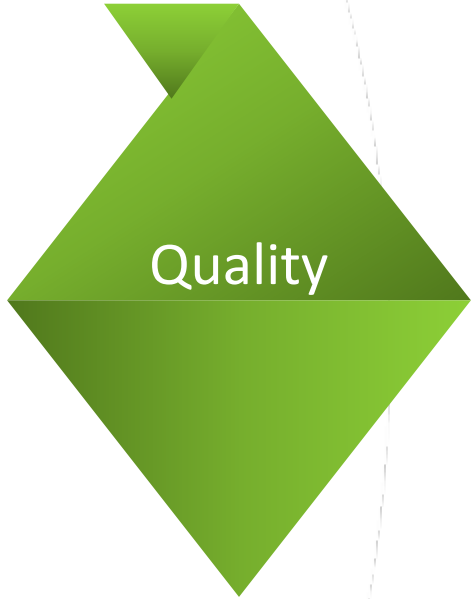
Agenda

- Values And Ideal Supplier Profile
- Westinghouse Procurement Process
- Safety & Non-Safety Related Steel Structures

Westinghouse Non-Negotiables for our Suppliers

Focus and Polices around "Zero-Accidents"
Management and personnel dedication to safety first



Dedication to Excellence
Implementation and documentation of the requirements and deviations

Procurement Integrity
Compliance and prompt reporting of violations or potential violations

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Westinghouse Supplier Expectations Summary

- Open for **close collaboration** with Westinghouse and other stakeholders.
- Can create and handle **complex** documentation.
- **Workshop capabilities**:
  - Cutting, Rolling, Welding, in house NDE (VT, UT, PT), Laser Tracker, Blasting & Painting, Storage for Carbon (most) and Duplex Steel.
  - Plates up to 3,7m width and 21,4m length.
  - Modules up to ~50-ton, multiple cranes for handling, enough space under the roof.
- Robust Quality Program **NQA-1 (safety)** and **ISO9001 (non-safety).**
- Personnel Certifications to **ASME, AWS, ASNT**.
- Software – **Primavera6, TEKLA.**

Introduction to Westinghouse Sourcing Process for AP1000® Plant

1 - Scope Definition
Critical requirements, export control, specific globalization needs

2 - Supplier Identification
Evaluate existing supply base and potential new suppliers considering BU potential needs for localization.

3 - Preliminary Supplier Assessment
Desktop supplier evaluations, issue and review RFQ's, down select to target suppliers

4 - Technical & Quality Eval.
Detailed evaluation (gap analysis) for development needs

8 - Product Delivery
Predictive delivery to support construction needs

7 - Supplier Management
Oversight plan, execution, and surveillance

6 - Supplier Development
Address supplier gap analysis, perform qualifications (as-needed), audits, finalize oversight plans

5 - Quality Audits
Supplier audits and onboarding to ASL/QSL

AP1000® Plant Supply Base Classification – Geographic Categories

Global Supplier

- Complex equipment with increased quality requirements (SR, ASME and/or EQ) and significant design impact to plant
- Large capital investment to engage in market with significant lead times (>4 yrs) driving limited global supply base
- IP constraints
- Examples include:
  - Steam Generators
  - Reactor Pressure Vessels
  - RCPs
  - RCL Piping

Regional Suppliers

- Complex equipment with increased quality requirements to non-safety or commercial fabrication
- Would require significant supplier development and qualification for some commodities
- Certain commodities would require capital investment to engage in market with significant lead times (>3 yrs)
- Examples include:
  - Structural Modules
  - Shield Building Segments
  - Fuel Handling Equipment
  - Cranes, Valves, Tanks, Pumps, etc.
  - Smaller Mechanical Modules
  - Electrical/I&C Equipment

Local Suppliers

- Typically, Non-safety or commercial fabrication requirements (limited additional qualification needed)
- Lead times allow for schedule float
- Multiple Sourcing Options
- Examples include:
  - Existing global suppliers leveraging local resources
  - Significant Construction Commodities (non-WEC scope)


Squib Valve


RCP

Steam Generator


Reactor Vessel



Large Structural Modules


Containment Vessel

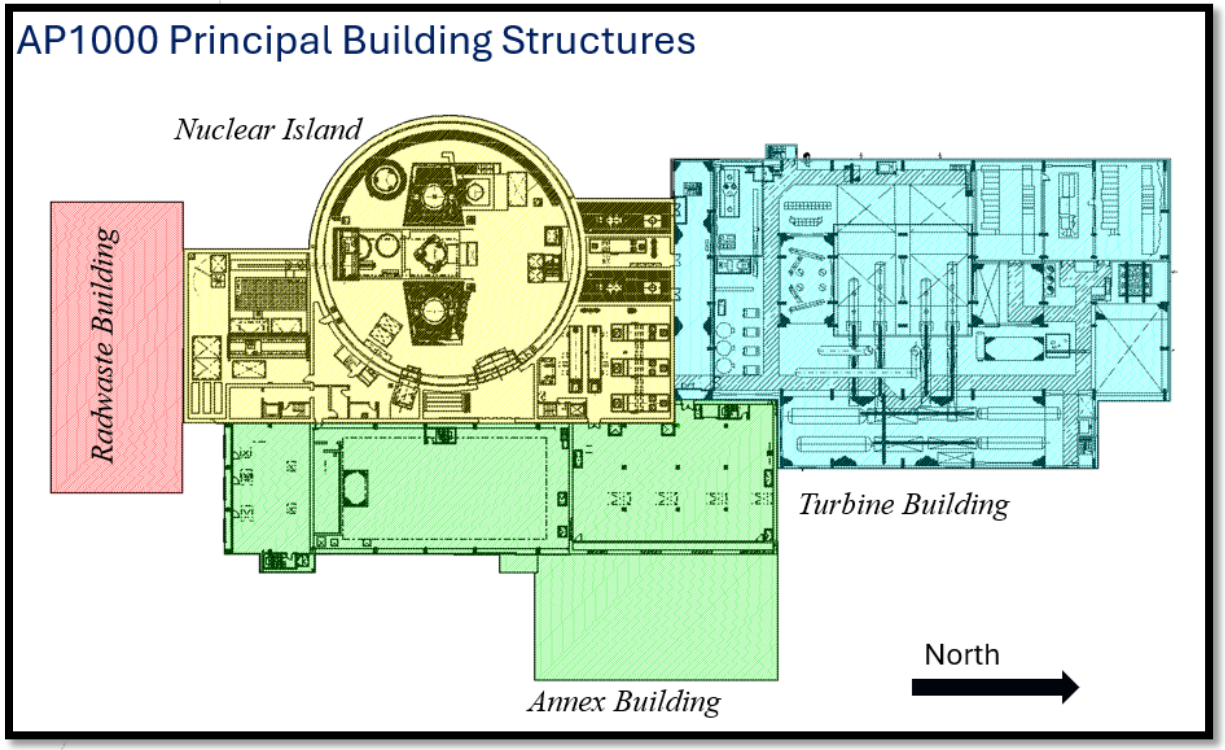

Non-Safety Valve


Transformers

Developing a <u>robust Supply Chain</u> to serve all projects across the region

Safety Classification Overview

- Safety Related:
  - Classification applied to items relied upon to remain functional during or following a design basis event to provide a safety-related function. Safety-related also applies to documentation and services affecting a safety-related item.
  - AP1000® Nuclear Island
    - Containment Vessel
    - Shield Building
    - Auxiliary Building
- Non-Safety-Related
  - Turbine Building
  - Annex Building
  - Radwaste Building
  - Diesel Generator Building



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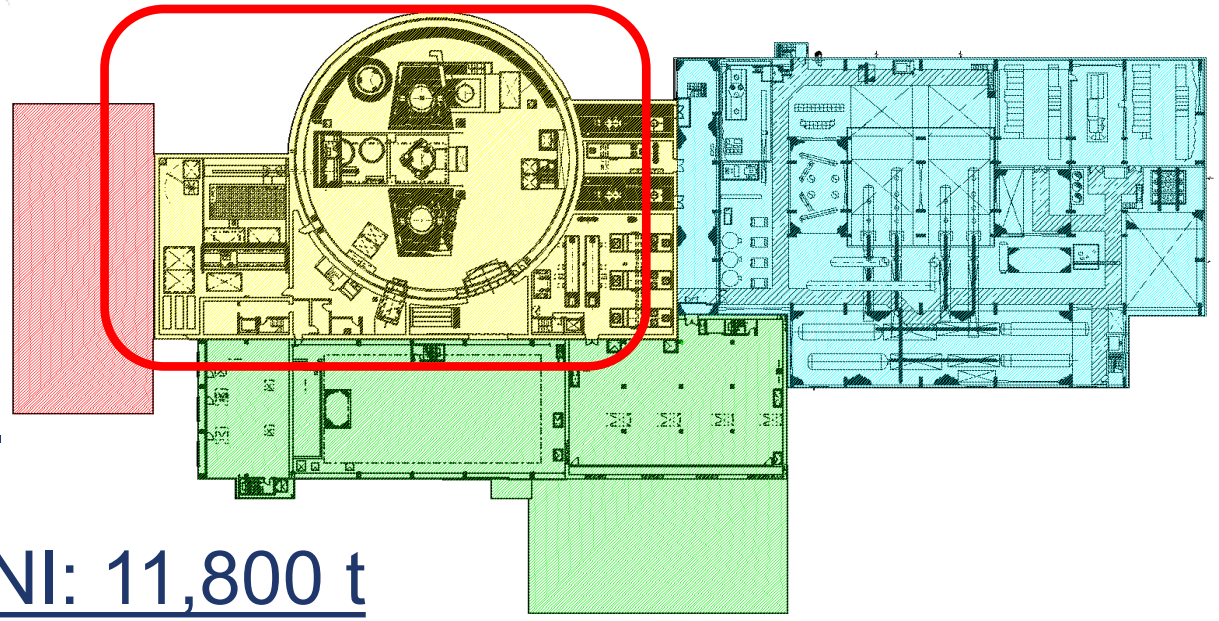
Safety-Related Steel Structures

Nuclear Island (NI) Structures

- Containment Vessel (CV)
- Shield Building (SB)
- Auxiliary Building (Aux)



- Safety-Related, Seismic Category I.

Total weight of structural steel in the NI: 11,800 t

Welding per AWS or ASME Section IX standards.

Westinghouse is currently working toward allowing European material substitutions for many of the structural scopes and materials.

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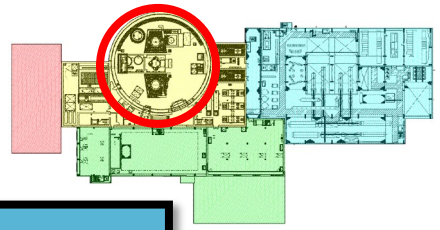
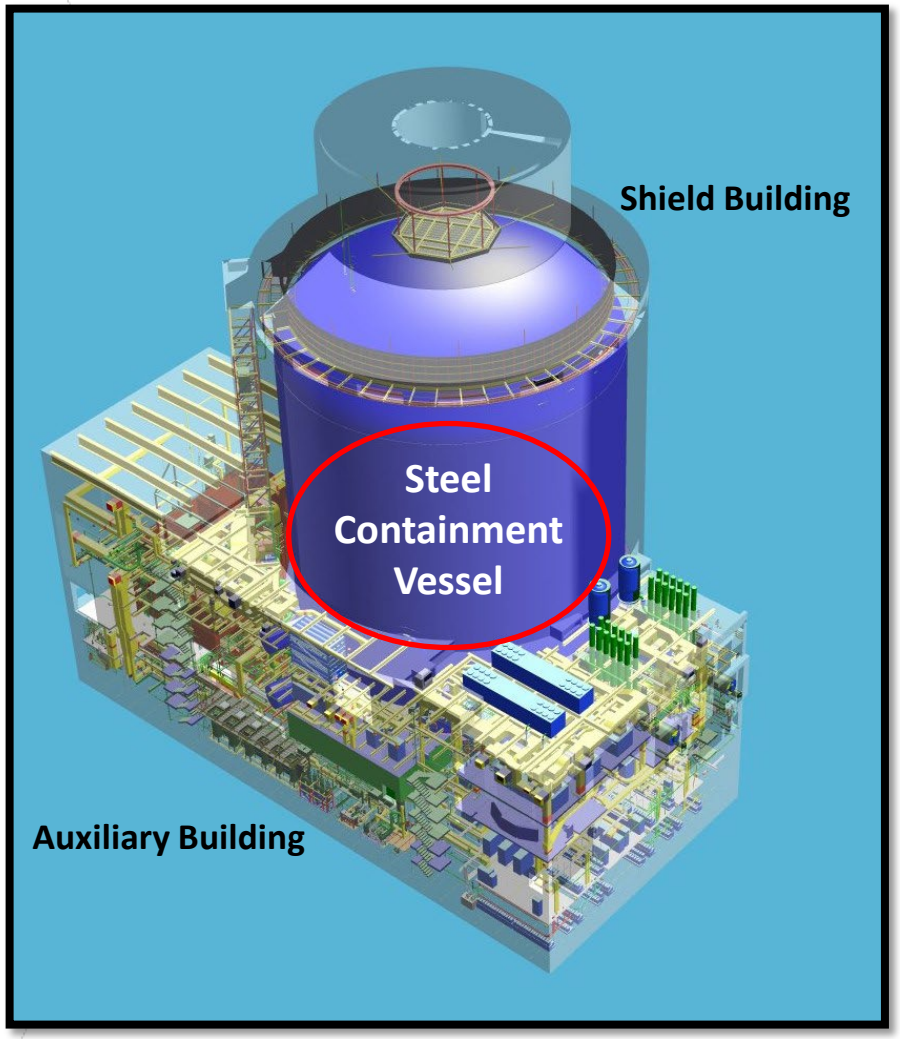
Safety-Related Steel Structures



Containment Vessel

- Functions:
  - ✓Provide shielding for the reactor core and the reactor coolant system during normal operations
  - ✓Contain the release of airborne radioactivity following postulated design basis accidents
  - ✓Remove sufficient energy from the containment to prevent the containment from exceeding its design pressure following postulated design basis accidents.



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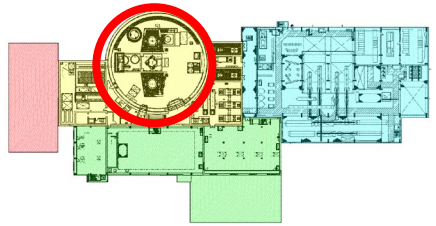
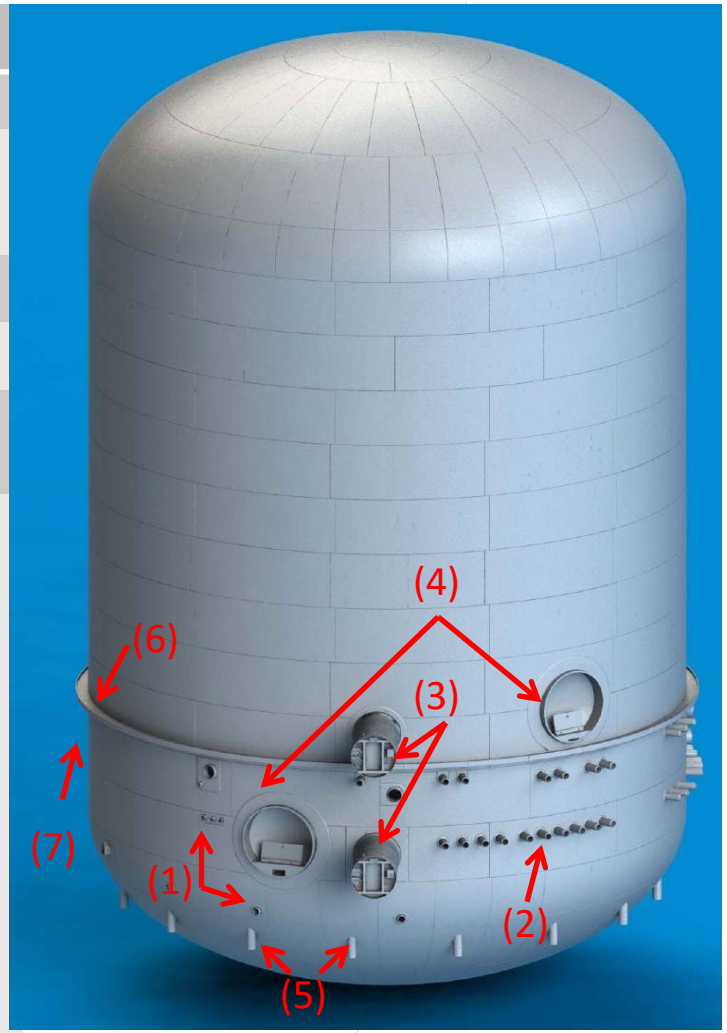
Safety-Related Steel Structures



Containment Vessel Details

Overall Height:	**215'-4" (65.6 m)**
Inside Diameter:	130'-0" (39.6 m)
Thickness	Heads: 1 5/8" (41.3 mm) Rings: 1 3/4" (44.5 mm) First Course: 1 7/8" (47.6 mm)
Head geometry:	Ellipsoid
Material:	SA738 Grade B
Design Code:	ASME Section III Division 1, Subsection NE, Class MC 2001 Edition with 2002 Addenda
Features:	1. Mechanical (piping) Penetrations (39) 2. Electrical Penetrations (29) 3. Airlocks (2) 4. Equipment Hatches (2) 5. Stub Columns (16) 6. Stiffeners (2) 7. Fuel Transfer Tube <u>Not Shown:</u> Girder for Polar Crane Shear Studs (~5520) Weir System U-Support Brackets (582) Attachment Plates for piping/equipment

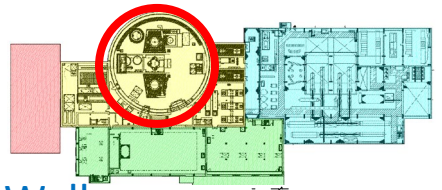


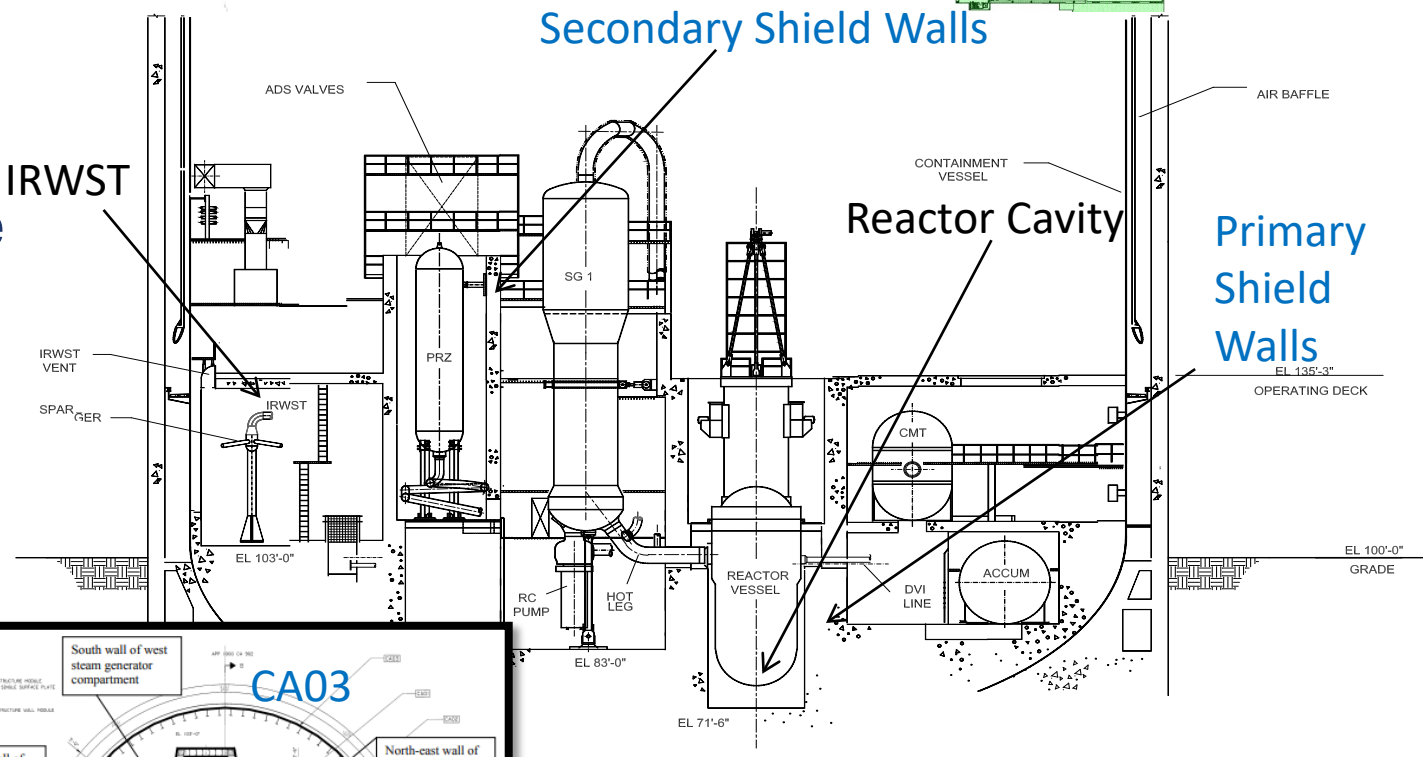
Vogtle Unit 3 containment vessel bottom head plates, after being fastened to assembly stand, are prepared for welding. September 21, 2011

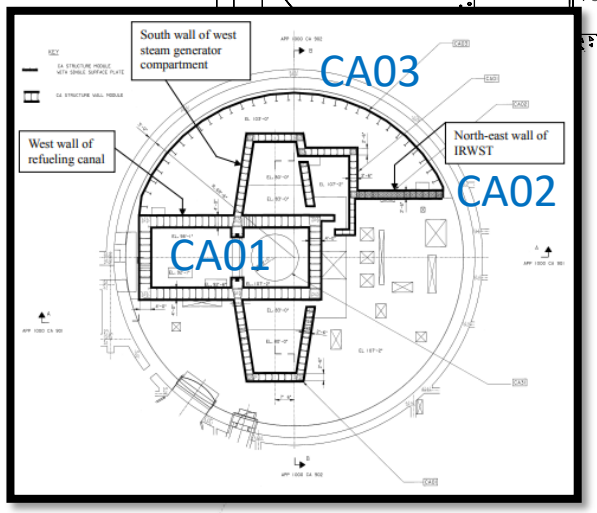
Safety-Related Steel Structures

Containment Vessel Internal Structures

- Concrete and steel structures inside (not part of) the containment pressure boundary, including:
  - Primary shield wall
  - Reactor cavity
  - Secondary shield walls
  - In-containment refueling water storage tank (IRWST)
  - Refueling cavity walls
  - Operating floor
  - Intermediate floors and various platforms

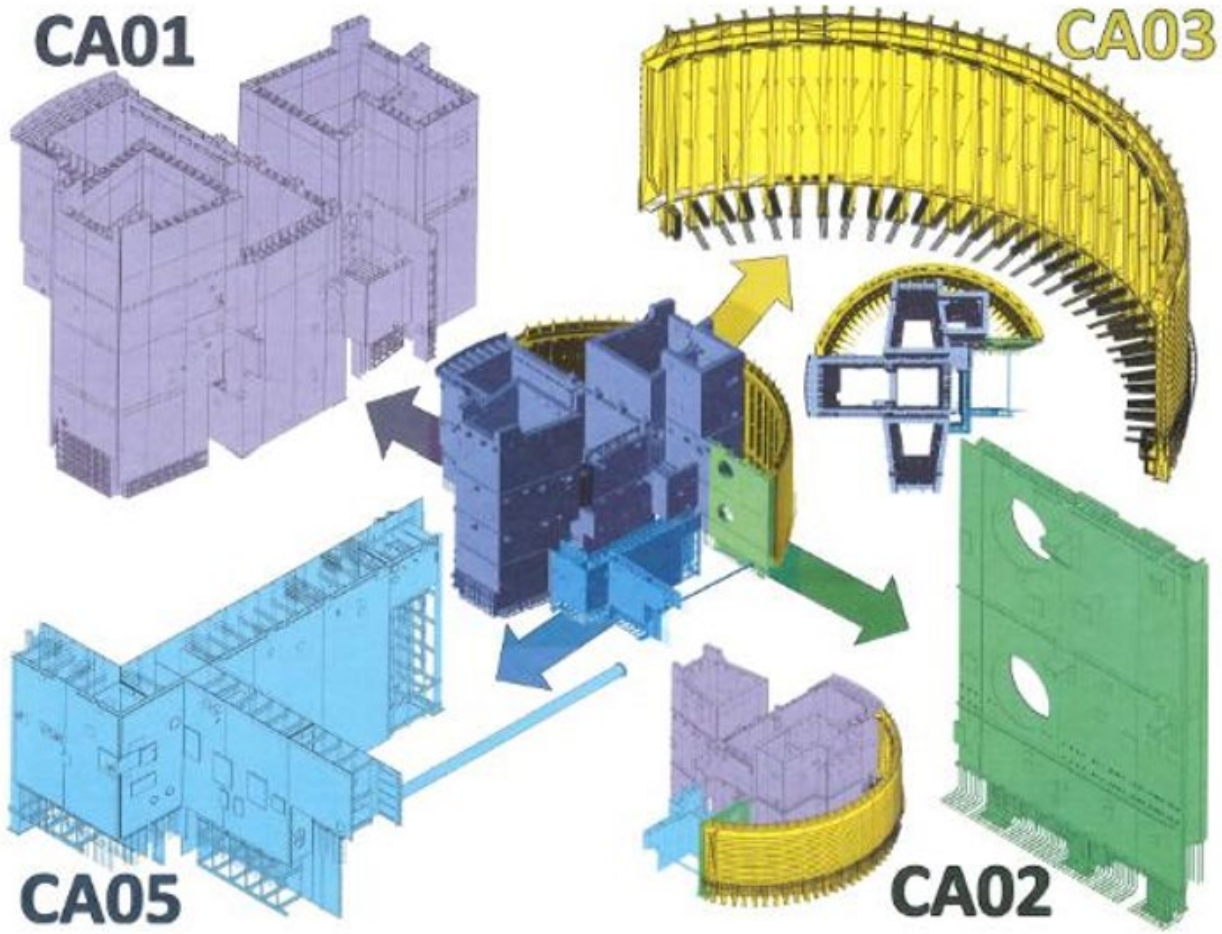






Safety-Related Steel Structures

Containment Vessel Internal Structures – Major CA Modules



Safety-Related Steel Structures

CA01 Steam Generator and Refueling Canal

47 pre-fabricated sub-modules:

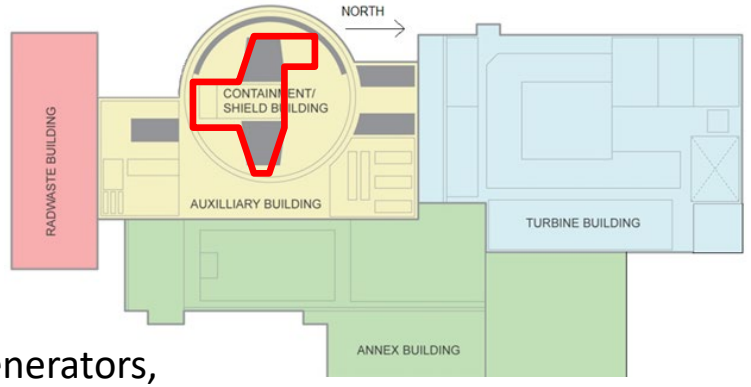
- Carbon Steel and Duplex Stainless Steel
- Max submodule size: up to 3.7 m x 7.7 m x 24.4 m
- Max plate size: T=19.1 mm W=3.7 m, L=21.4 m
- Max submodule weight ~45.4 t
- Typical submodule weight ~ 8.2-10 t

Assembled (on site) Size (L x W x Height):

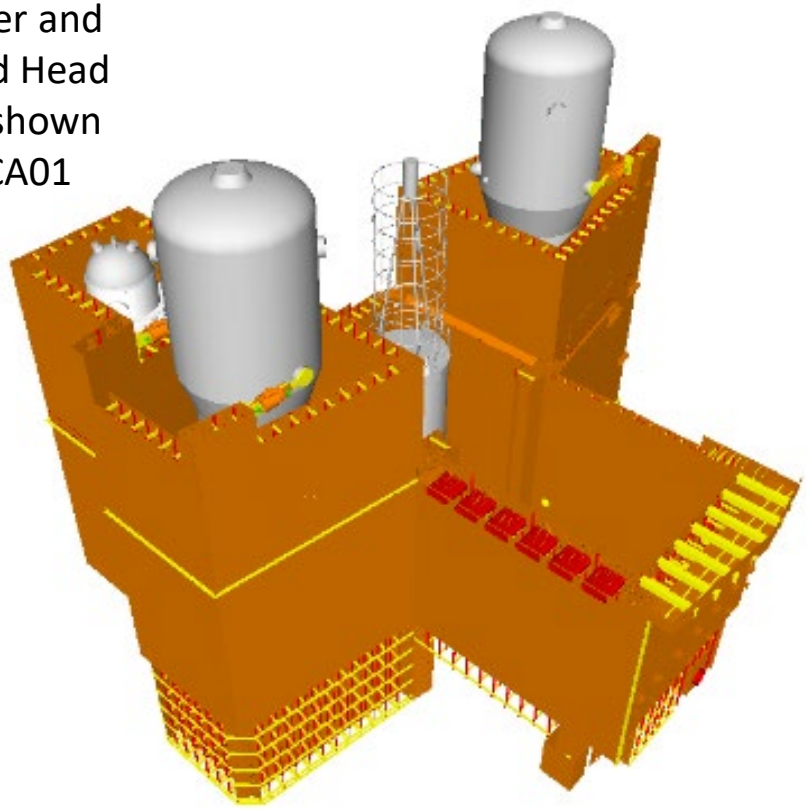
- 28 m x 29.3 m x 23.2 m

Assembled (on site) Lift Weight:

- ~1,069 t



Steam Generators, Pressurizer and Integrated Head Package shown inside CA01



Safety-Related Steel Structures

CA02 IRWST / Pressurizer Wall Module

5 pre-fabricated submodules:

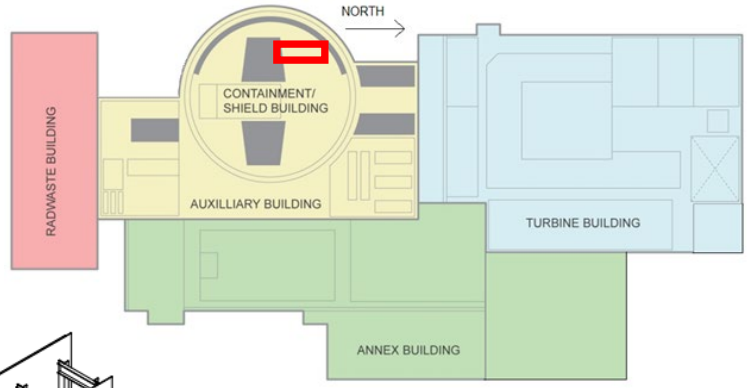
- Carbon Steel and Duplex Stainless Steel
- Max plate sizes:
  - T=12.7 mm W=3.1 m, L=11.4 m (Stainless)
  - T=19.1 mm W=3.1 m, L=10.9 m (Carbon)
- Max submodule weight ~ 12.2 t
- Typical submodule weight ~ 5 t

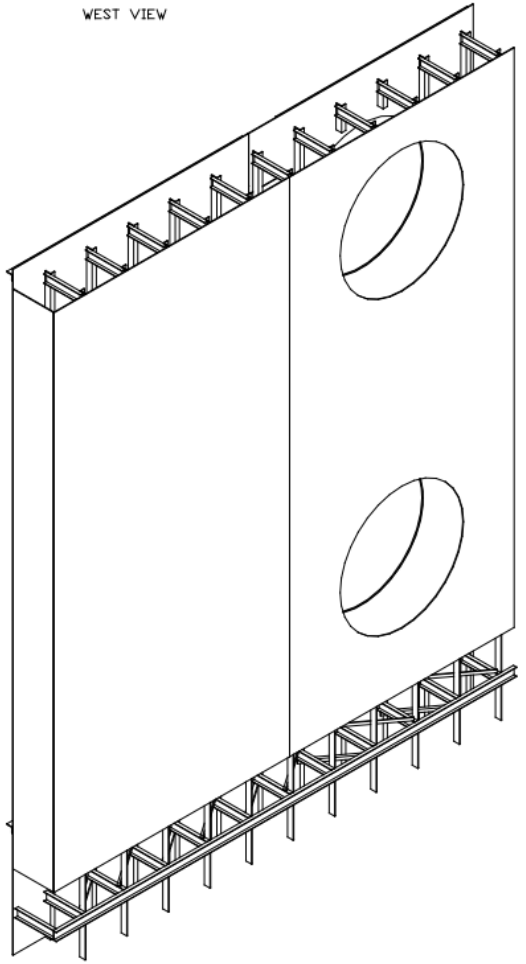
Assembled (on site) Size (L x W x Height):

- 8.8 m x 2.2 m x 12.3 m

Assembled (on site) Lift Weight:

- ~40 t





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Safety-Related Steel Structures

CA03 IRWST Wall Module

17 pre-fabricated submodules:

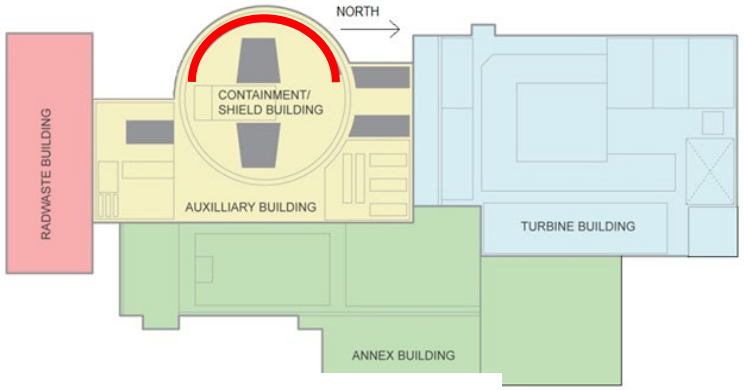
- Duplex Stainless Steel
- Max submodule size: 2.8 m x 12.8m x 1.4 m
- Max plate size: T=15.9mm W=2.9m, L=10.3m
- Max (and typical) submodule weight ~ 8 t

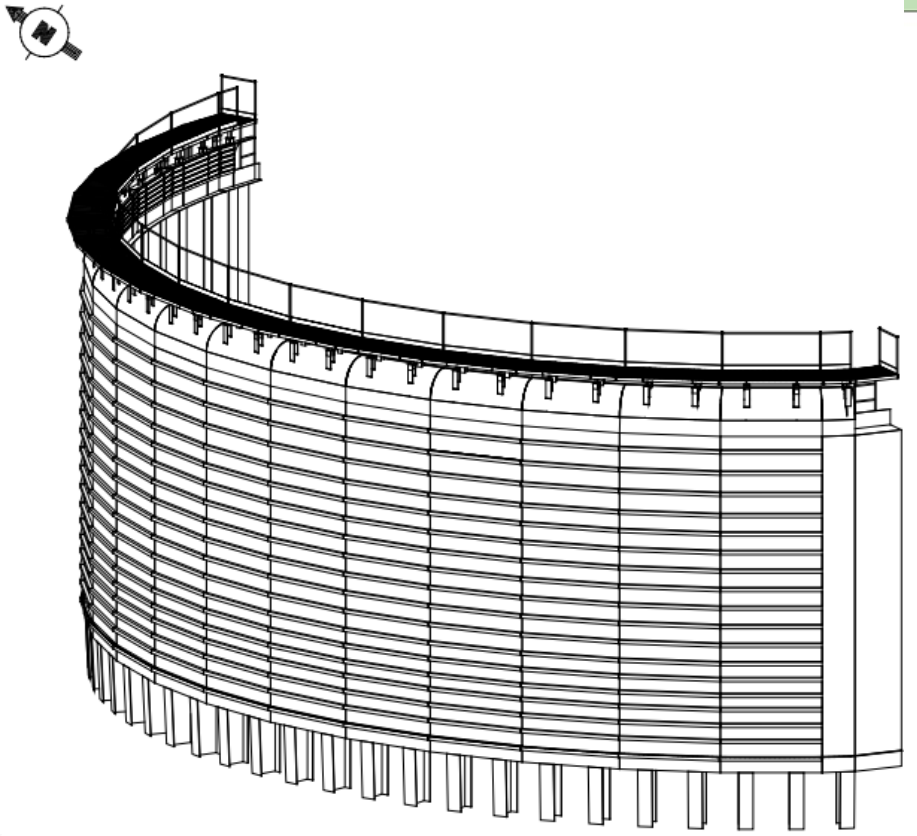
Assembled (on site) Size (L x W x Height):

- 35.5 m x 14.5 m x 13.0 m

Assembled (on site) Lift Weight:

- ~140 t





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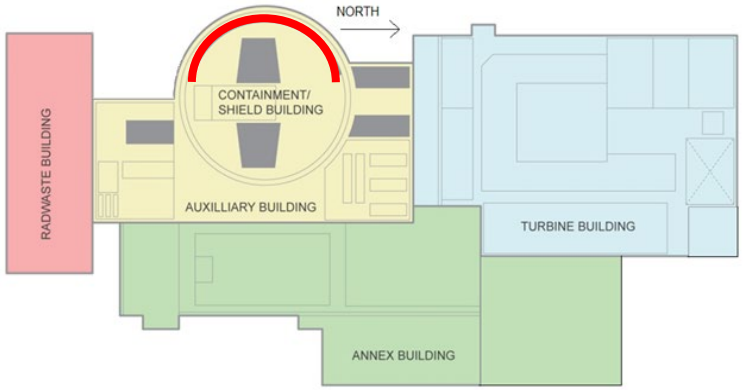
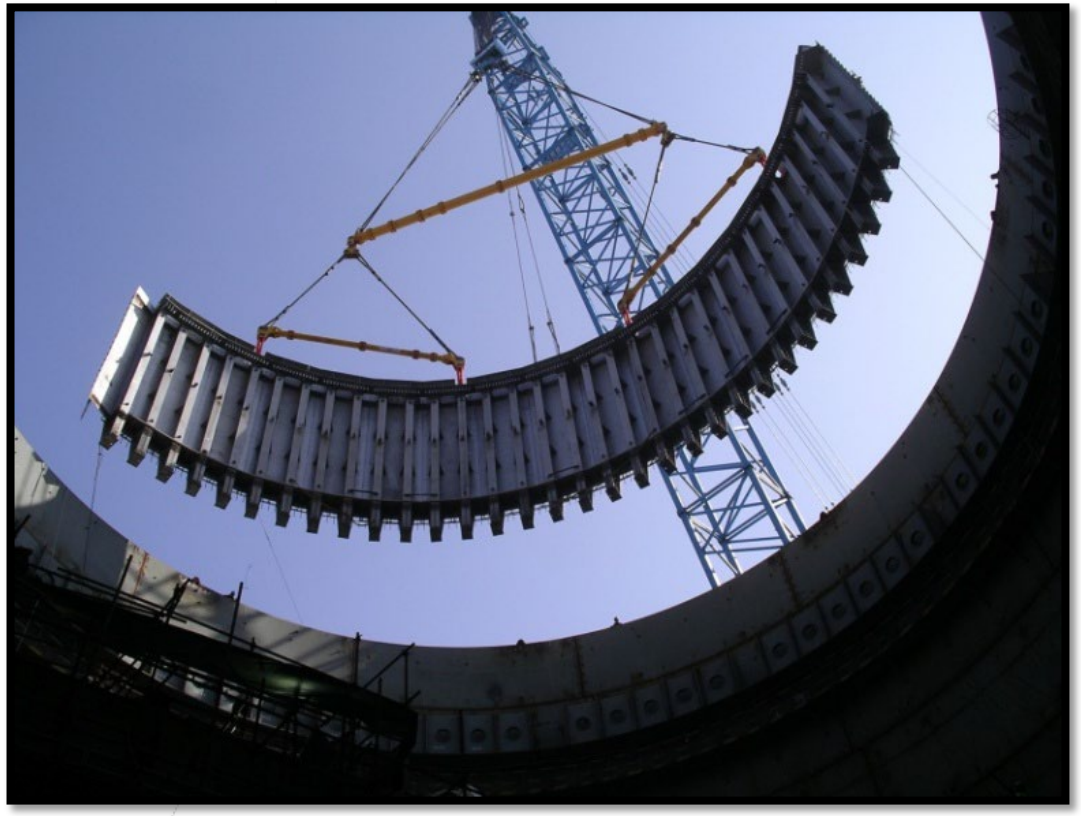
Safety-Related Steel Structures

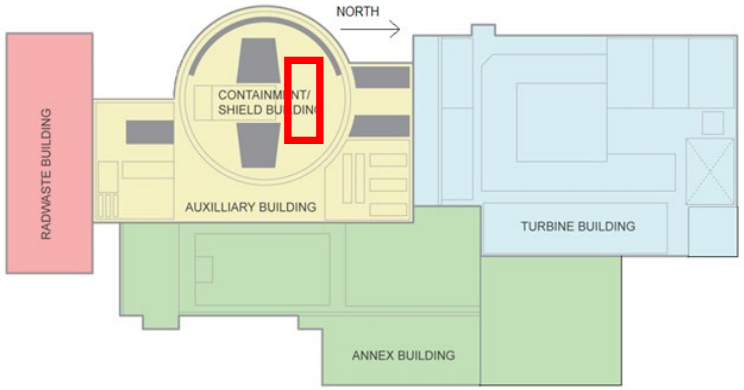
CA03 IRWST Wall Module





Safety-Related Steel Structures

CA05 CVS / Access Tunnel / PXS-B Walls



5 pre-fabricated submodules:

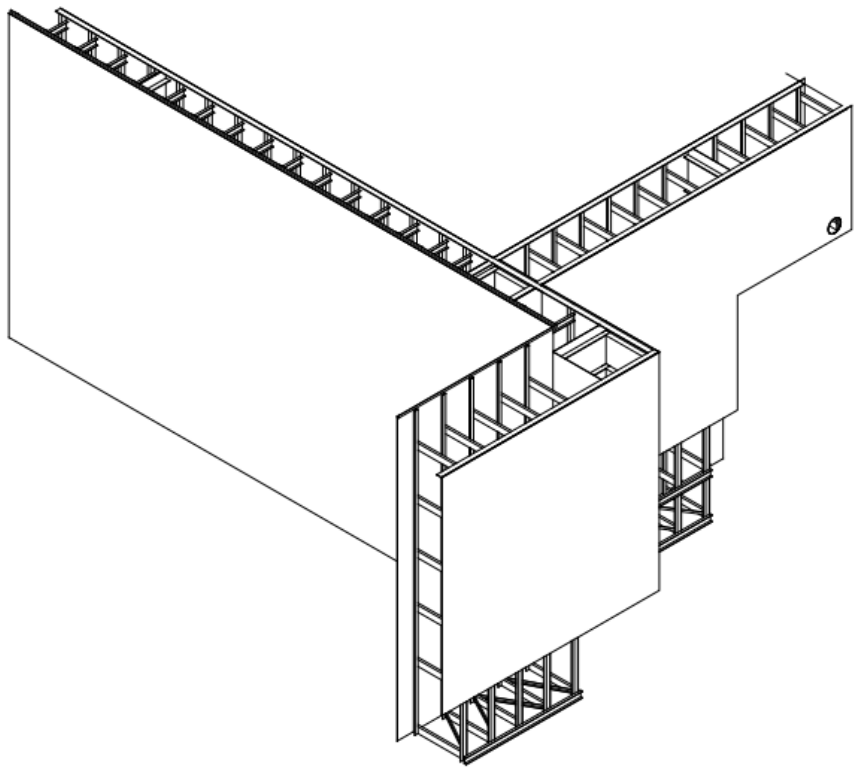
- Carbon Steel (some Stainless-Steel plates)
- Max plate size: T=19.1mm W=3.6m, L=7.5m
- Max submodule weight ~15.6 t
- Typical submodule weight ~9.2 t

Assembled (on site) Size (L x W x Height):

- 13.3m x 15.7m x 8.1m

Assembled (on site) Lift Weight:

- ~75 t



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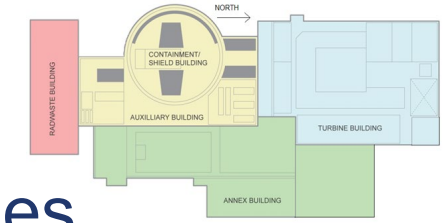
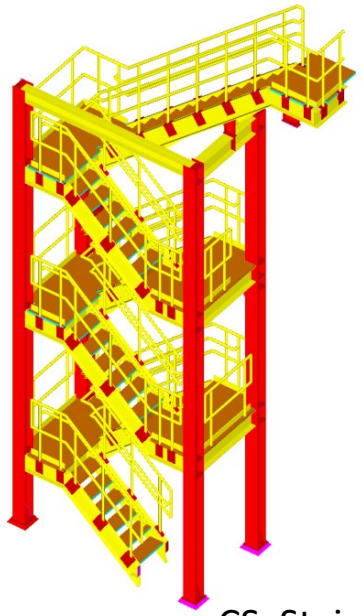
Safety-Related Steel Structures

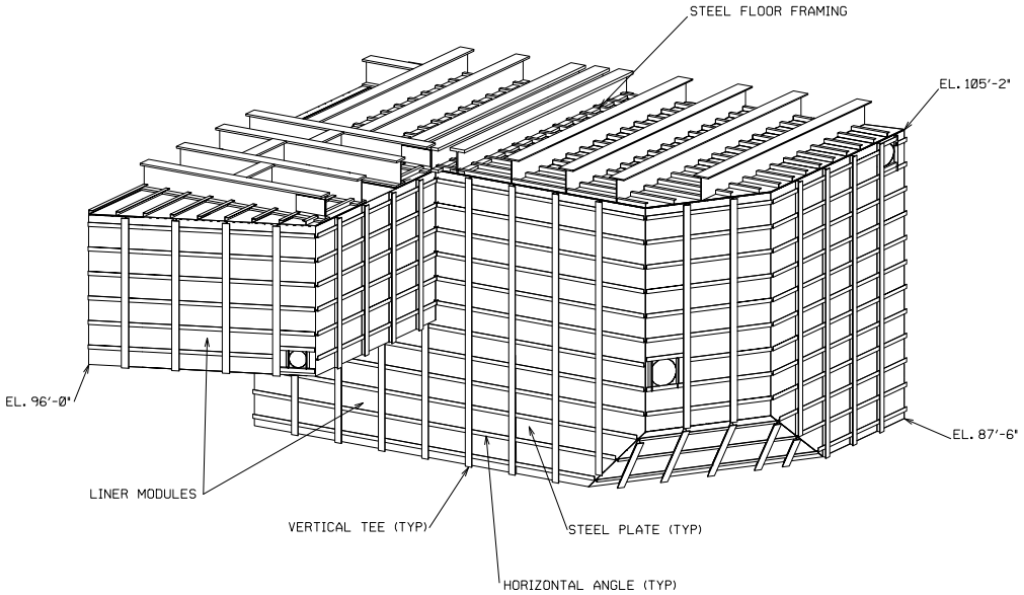


Containment Vessel Internal Structures – Other CA & CB Modules

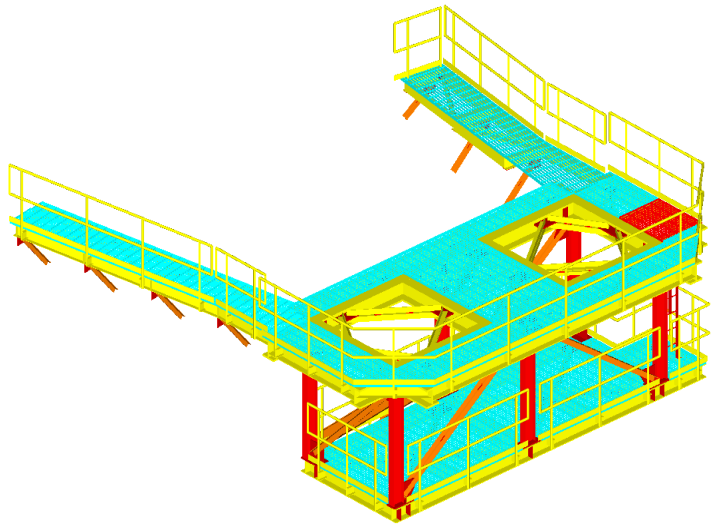
- CAxx/CBxx – Other Floor and Liner Modules
- Located at various elevations inside containment.
- Steel form modules, functioning as permanent formwork.
- Plate reinforced with angle stiffeners and tee sections and having welded studs to transfer loads to the concrete.



CS Stairs Module

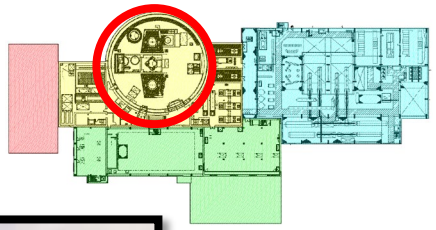


CA & CB Modules



CH Platform Module

Safety-Related Steel Structures



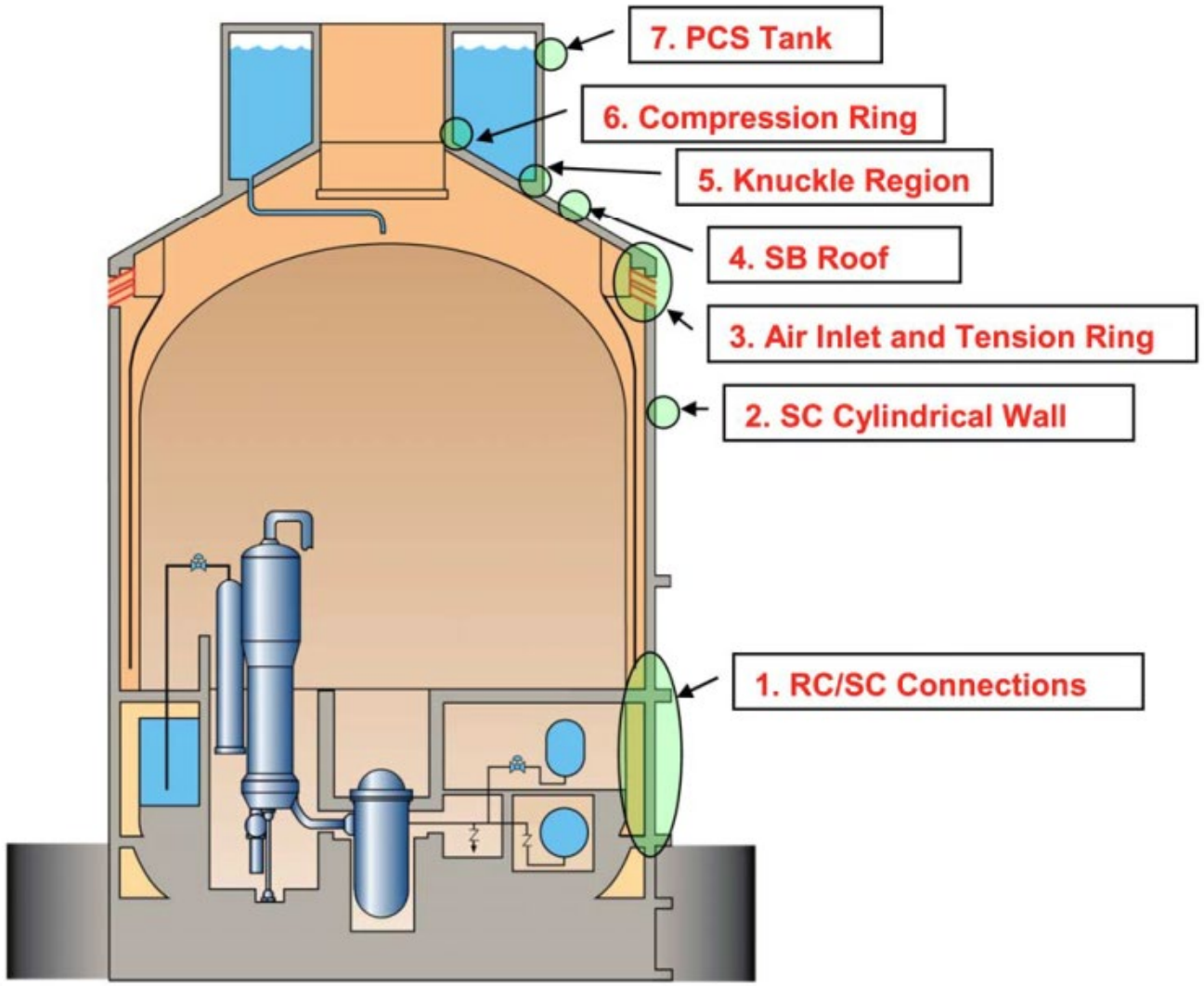
Shield Building

- The shield building is the structure and annulus area that surrounds the containment building.
- Shares a common basemat with the containment vessel and the auxiliary building.
- Uses concrete-filled steel plate (or steel composite) construction (SC) as well as reinforced concrete (RC) structure.
- The overall configuration of the shield building is established from functional requirements related to radiation shielding, missile barrier, passive containment cooling, tornado, and seismic event protection.
- Governing Codes & Standards: ACI 349-01, ANSI/AISC N690-1994, AWS D1.1, D1.4, D1.6.
- Safety Class C, Seismic Category 1

Safety-Related Steel Structures

Shield Building – Key Areas

- RC/SC connections
- Shield building cylindrical structure
- Air inlet and tension ring
- Shield building roof structure
- Knuckle region (connection to exterior wall of PCS tank)
- Compression ring (connection to interior wall of PCS tank)
- Passive containment cooling system (PCS) water storage tank (PCCWST)



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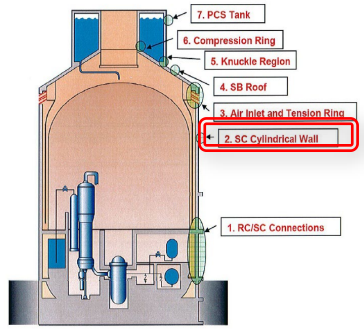
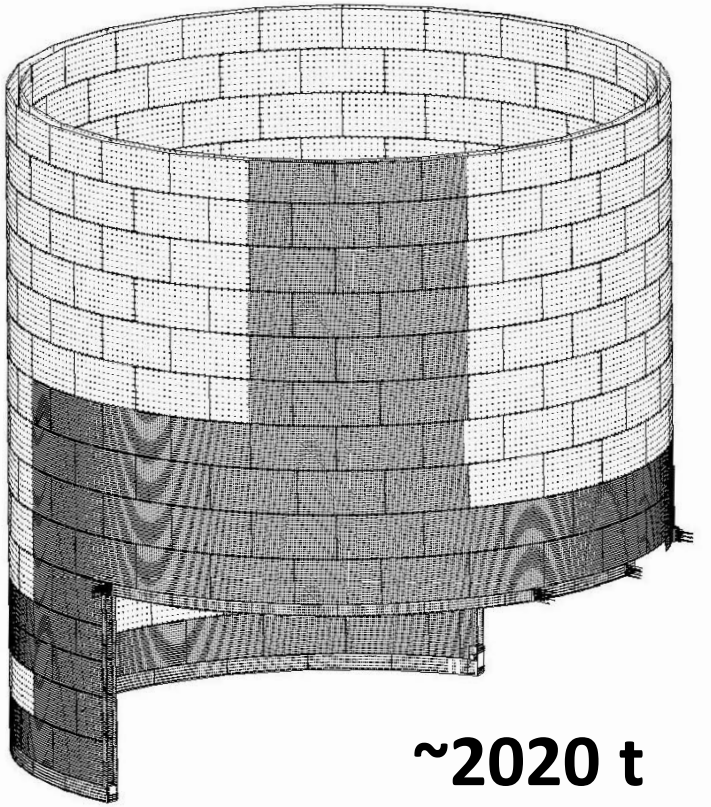
Safety-Related Steel Structures

Shield Building Cylindrical Panels (SC40)



- Outside Radius 22.1 m, Thickness 0.9m
- Steel Composite (SC) construction with steel plates, tie bars, and shear studs.
- For each (1) unit, there are 16 courses of panels, for a total of 167 panels.
- Primary material: A572 GR50 plate with special chemical and mechanical requirements, as well as a requirement to pass Charpy V-Notch testing at -56.7 degrees Celsius.

Description	Quantity	Notes
RC/SC Connection Panels • 1 – Horizontal Connection • 2 – Vertical Connection	17	Connection panels to the Shield Building Wall Reinforced Concrete portion. Also used for Aux Bldg Roof & Wall connections to SC panels.
Type 1 Panels	47	Considered high stress, have tighter spacing of tie bars, more reinforcing, backup plates, no studs, and are considered more complex to fabricate.
Type 2 Panels	91	Considered low stress, wider spacing of alternating tie bars and studs, are considered less complex to fabricate.
Type 1 / 2 (Hybrid) Panels	12	



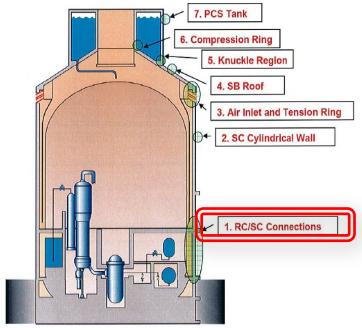
~2020 t

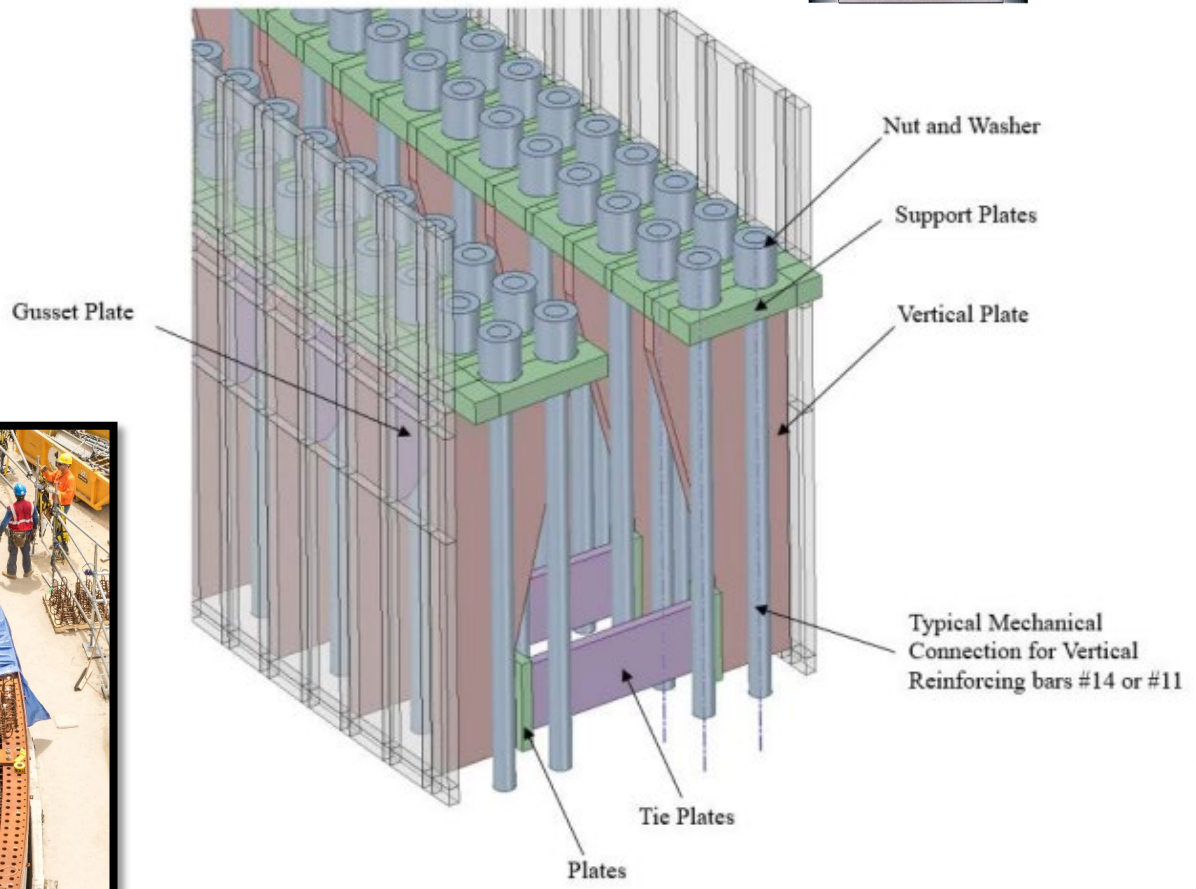
Safety-Related Steel Structures

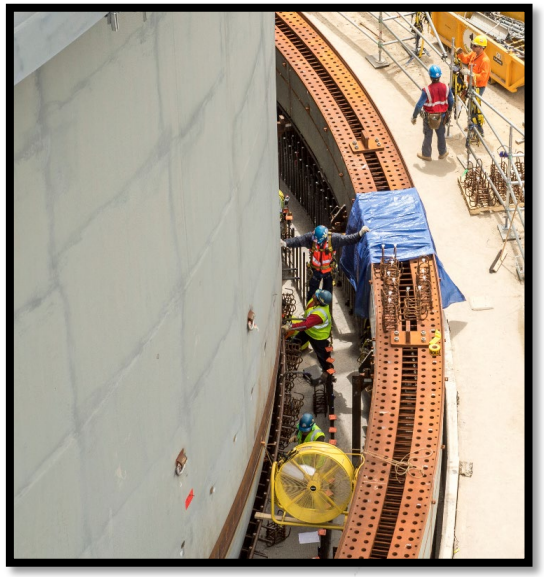
Shield Building (SC40) – RC/SC Connection Panels

- (L x H x T) 11.6m x 1.1m x 0.91m
- A572 Gr 50 (*) Liner Plate 25.4mm thick
- A572 Gr 50 (*) Reinforcing/Support Plates
- Aprox. Weight = 14 t
- Tie Bar #6 A706 Gr.60

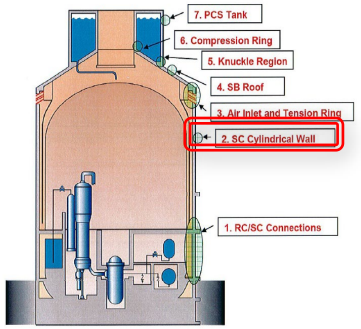
*With special requirements per material specification.







Safety-Related Steel Structures

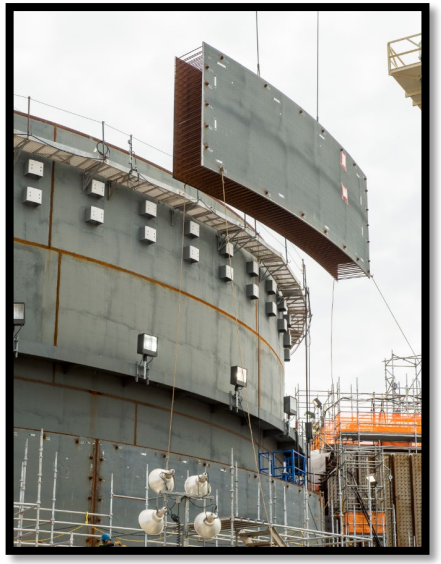


Shield Building (SC40) – Cylindrical Panels

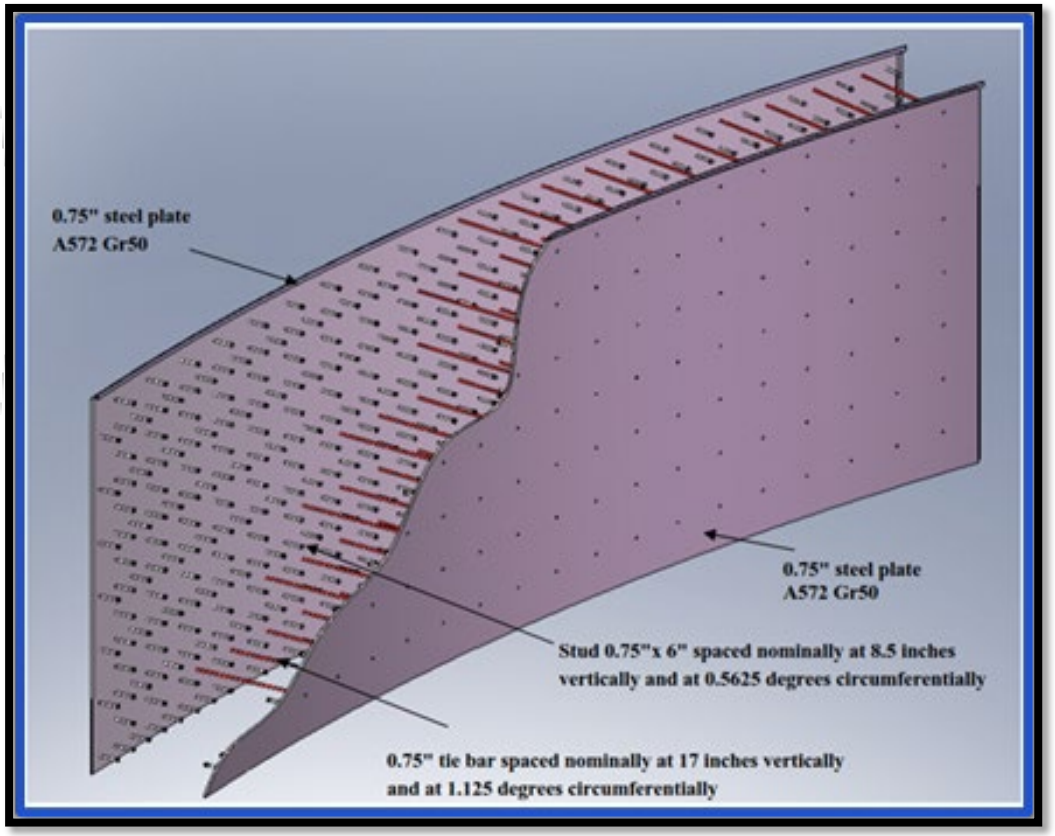
- (L x H x T) 11.6m x 3m x 0.91m
- Aprox. Weight= 14 t to 23 t (with wall connections)
- A572 Gr 50 (*) Liner Plate 19.1mm thick
- Tie Bar #6 A706 Gr.60
- Studs ¾” x 6” ASTM A108

*With special requirements per material specification.

Type 1 SC Panel w/ Wall Connection



Type 2 SC Panel

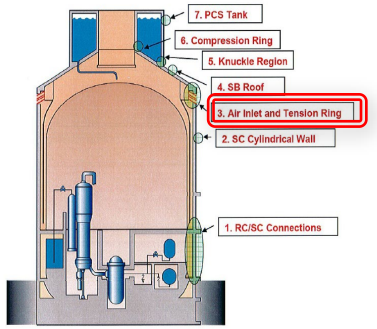


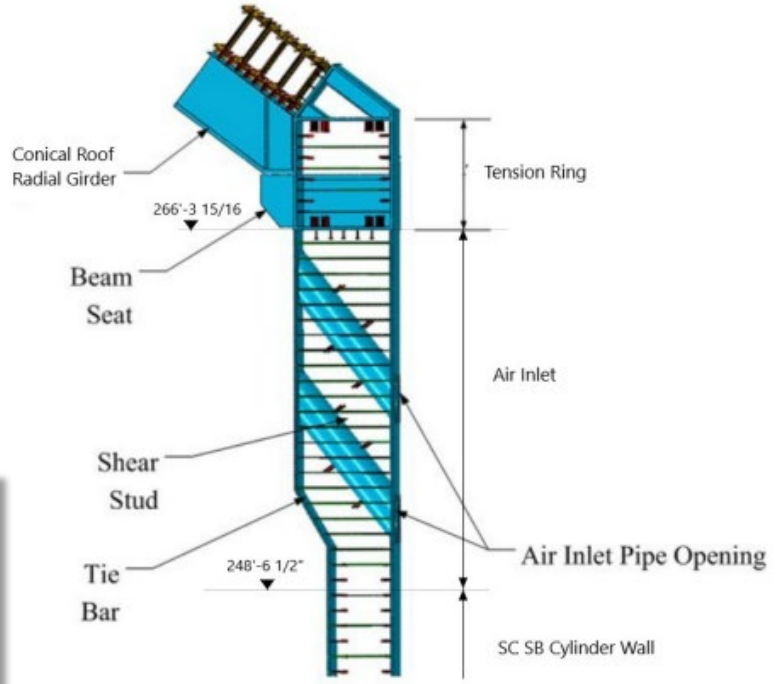
Type 2 SC Panel

Safety-Related Steel Structures

Shield Building (SC30) – Air Inlet & Tension Ring

- The tension ring is the interface between the SC Air Inlet structures and the shield building conical roof.
- The air inlets structure is a 1.37 m thick steel composite structure with through-wall openings for air flow for natural circulation of cooling air. The top of the air inlets structure is welded to the bottom of the tension ring, and the bottom is welded to the top of the SC cylindrical wall.





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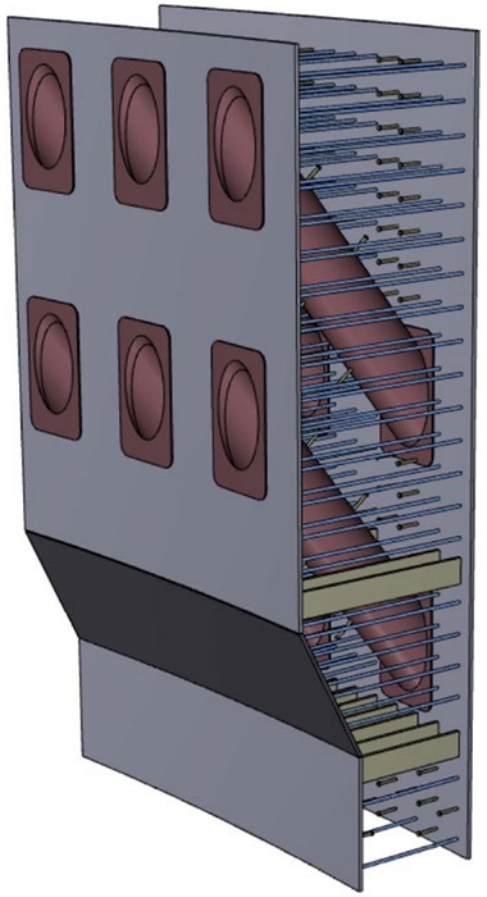
Safety-Related Steel Structures

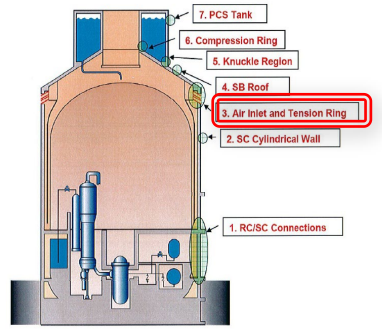
Shield Building (SC30)

- Air Inlet Panel
  - 43 panels (submodules)
  - (L x H x T) 3.2m x 5.4m x 1.37m
  - Weight Aprox. 12 t per panel
  - Liner Plate **25.4mm** thick A572 Gr.50 (*)
  - Studs ¾ x 6 in. A108
  - Tie Bar #6 A706 Gr.60
  - Pipes 45.72cm OD
  - (*) with special requirements per material specification.

  - **Total Weight = ~516 t**

Attaching to Tension Ring (SC30)





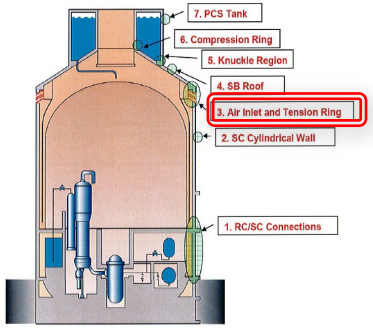
Attaching to SC Panels (SC40)

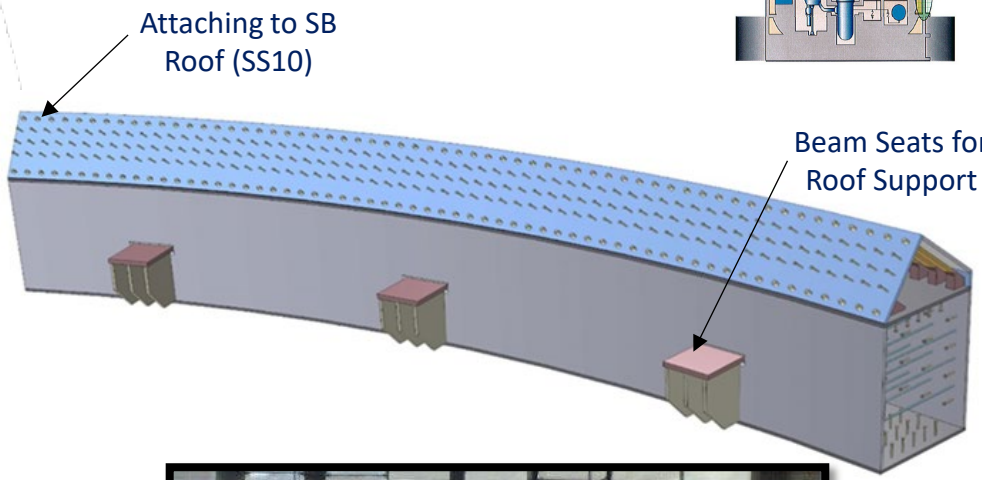
Safety-Related Steel Structures

Shield Building (SC30)

- Tension Ring
  - 11 panels (submodules). Includes beam seats for roof.
  - (L x H x T) 13.1m x 2.3m x 1.37m
  - Weight Aprox. 37 t per panel
  - Liner Plate 38.1mm thick A572 Gr.50 (*)
  - Studs ¾ x 6 in. A108
  - Tie Bar #6 A706 Gr.60
  - Beam Seat 57.2mm thick Plate. A572 Gr.50 (*)
  - Weldable couplers (#11 LENTON EL36C3J or approved equivalent)
  - (*) with special requirements per material specification.

  - Total Weight = ~ 407 t

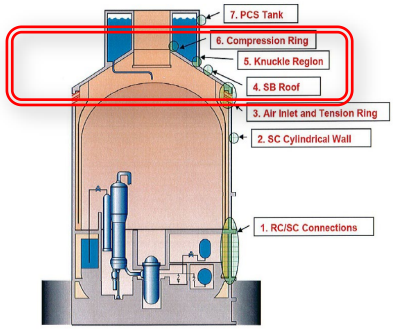




Attaching to Air Inlet (SC30

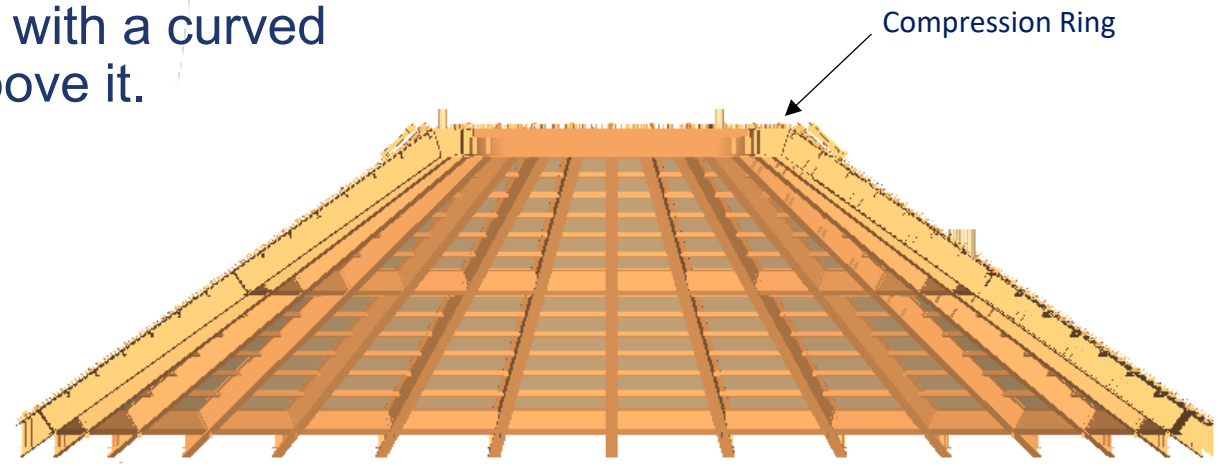
During Fabrication

Safety-Related Steel Structures

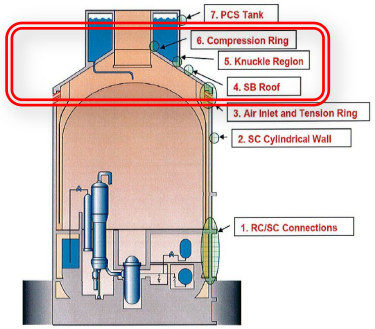


Shield Building (SS10) – Conical Roof

- Steel Structure
- 32 radial beams
- Between each pair of radial beams there are circumferential beams.
- A Steel plate is welded to the top flanges of each beam and forms a surface on which the concrete pad is placed.
- The steel structure forms a conical shell that spans the area from the compression ring to the tension ring.
- The compression ring is a composite structure with a curved girder section and supports the roof directly above it.
- The concrete roof slab is cast in place.

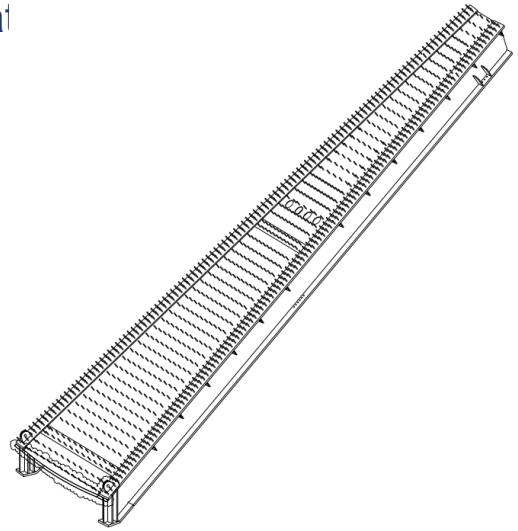


Safety-Related Steel Structures



Shield Building (SS10) – Conical Roof Submodule

- 16 sectors, plus 16x2 liner plates w/studs
- 57 x 14.8 x 3.20 m (L x W x T)
- Studs ¾ x 6 in.
- SB built-up roof girders (429mm x 973mm, web 38mm, flange 57mm)
- Girder Plates (38.1/57.2 mm thick). A572 Gr.50 (*)
- Floor Liner 12.7mm thick. A572 Gr.50 (*)
- Channels MC10 x 28.5 & MC10x22 A992
- (*) with special requirements per material specifica



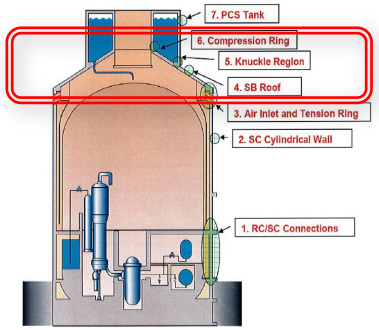
Liner Plates
(not yet installed)

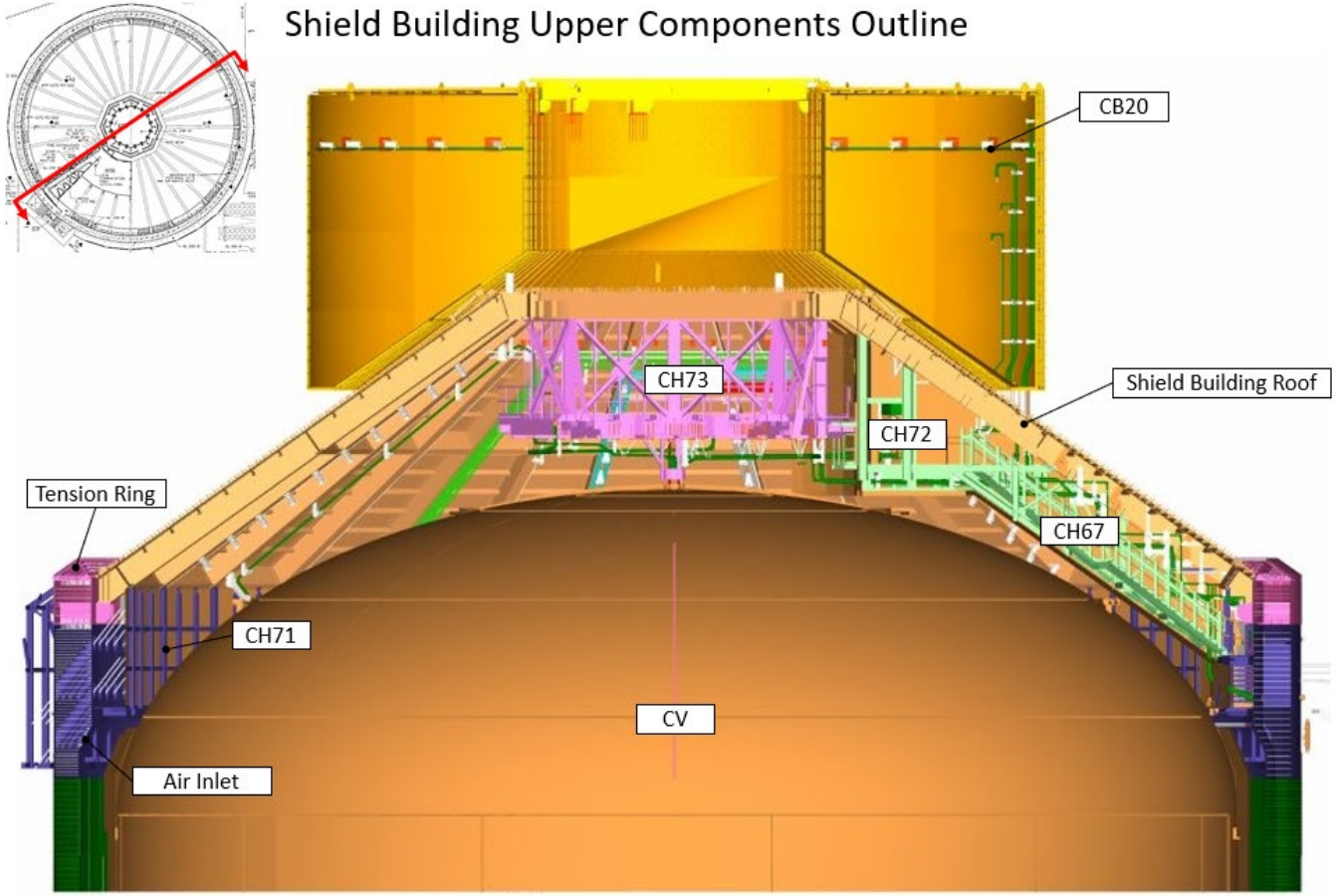
Submodule

~750 t

Safety-Related Steel Structures

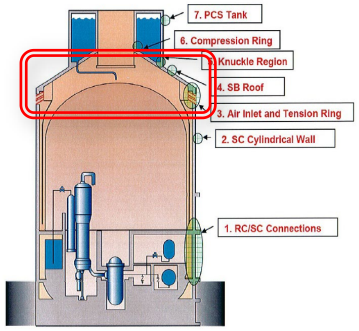
- Shield Building Roof –Stair & Platform Modules



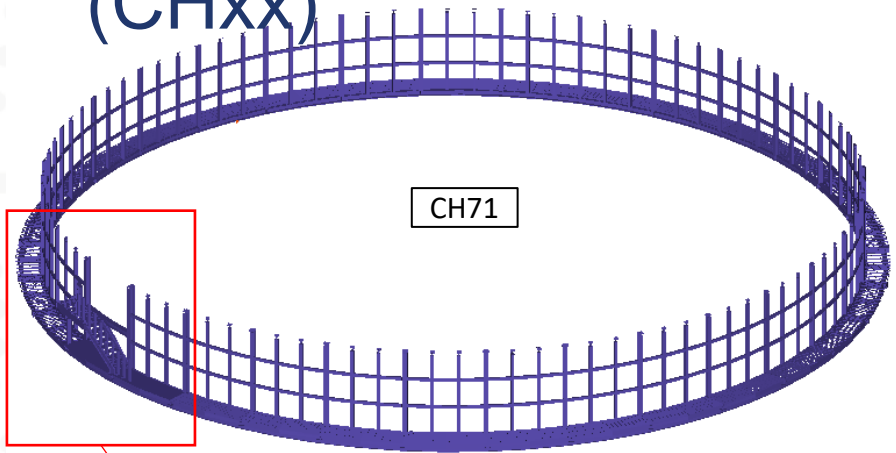


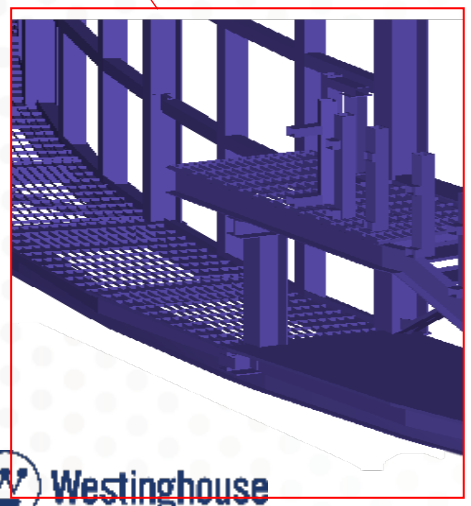
Section View

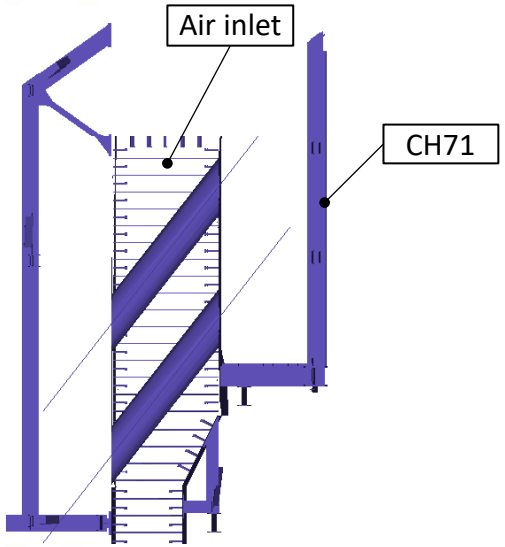
Safety-Related Steel Structures



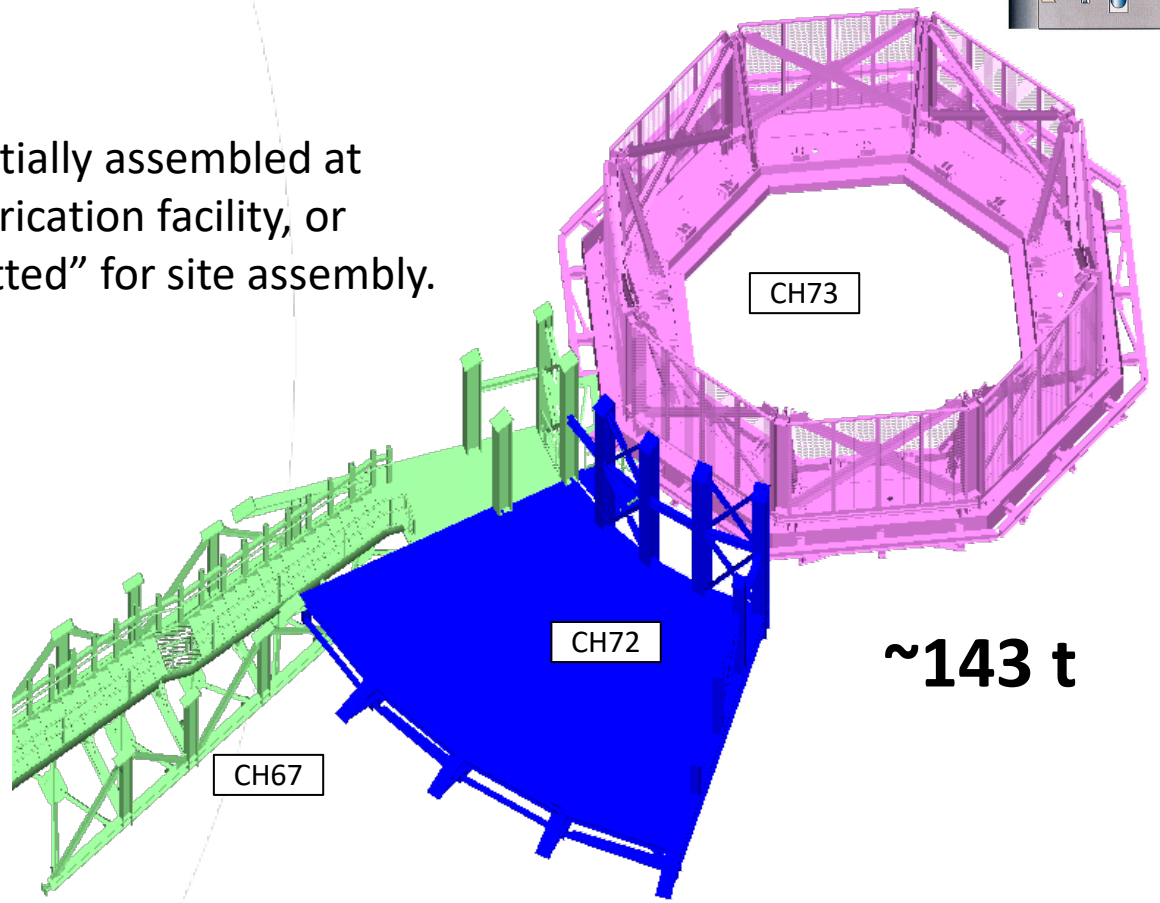
- Shield Building – Conical Roof Stair & Platform Modules (CHxx)





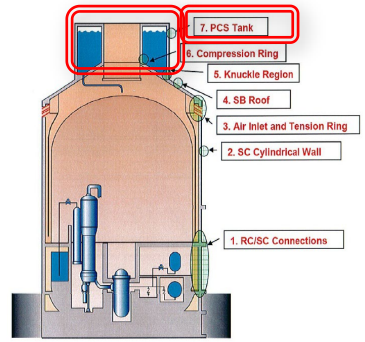


Partially assembled at fabrication facility, or "kitted" for site assembly.

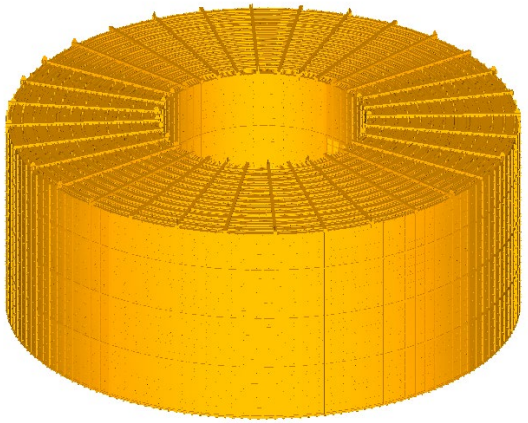


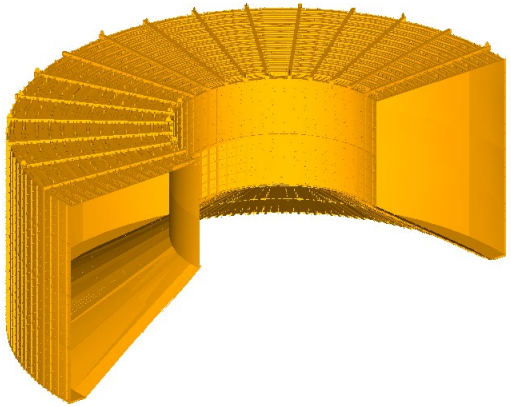
~143 t

Safety-Related Steel Structures

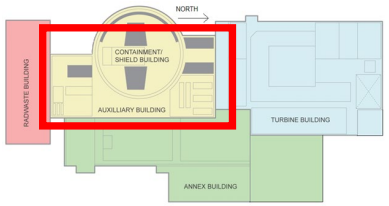


- Shield Building – PCS Tank Module (CB20)
  - Located on top of the SB Roof
  - 112 submodules; Max submodule weight: 5 t ; Total module weight ~302 t
  - Consists of 12.7mm steel plates that form the external walls, internal walls, roof, and bottom of the liner, reinforced by WT shape and L shape structural steel stiffeners. There are also C6x10.5 leak chase channels located at the construction joints of the CB20 module.
  - Materials include:
    - Plate material - ASTM A240 S32101 stainless steel or ASTM A572 Gr 50 steel, depending on placement and use of piece
    - Rolled Shapes - ASTM A992 carbon steel, ASTM A572 Gr50 carbon steel, ASTM A276 TP304L stainless steel, depending on placement and use of piece.
    - Stainless Steel Floor Plate - ASTM A793 TP304L



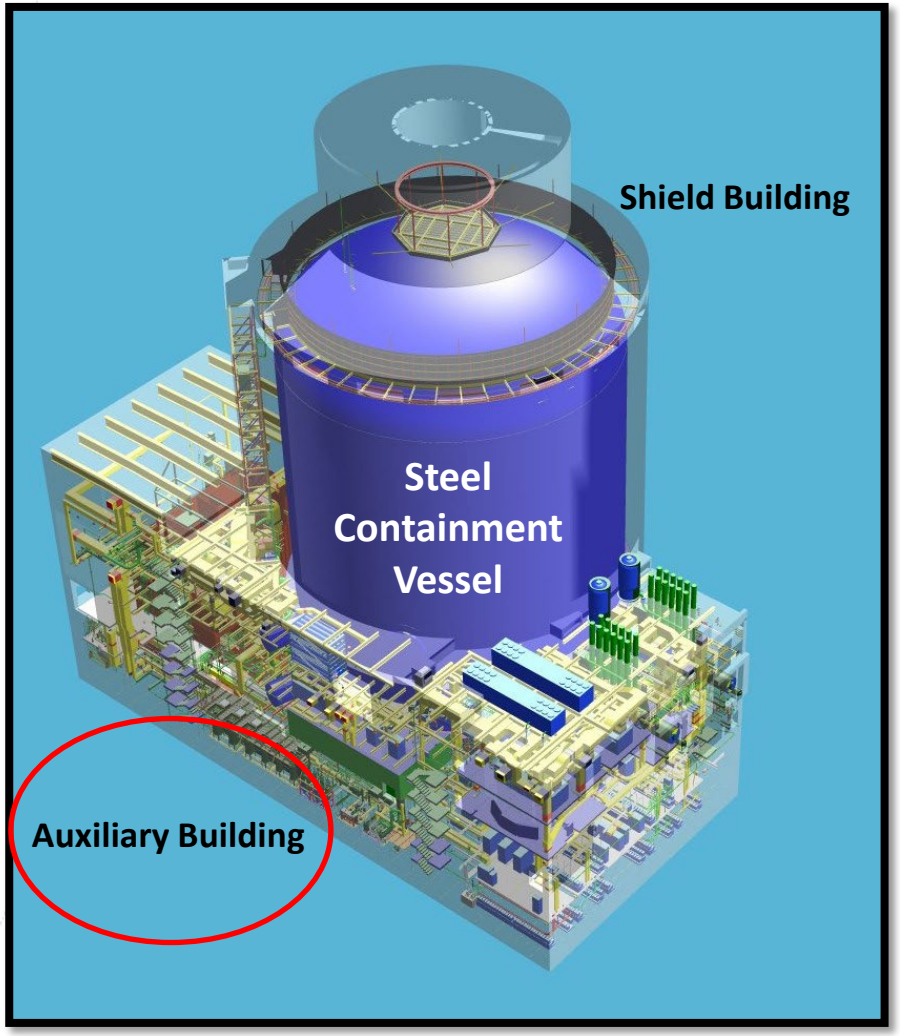


Safety-Related Steel Structures



Auxiliary Building

- C-shaped section of the nuclear island that wraps around approximately 50 percent of the circumference of the shield building.
- Provides protection and separation for the seismic Category I mechanical and electrical equipment located outside the containment building.
- Reinforced concrete and structural steel structure.
- Governing Codes & Standards: same as rest of nuclear island.
- Main structural materials generally the same as Shield Building.
- Safety Class C, Seismic Category 1



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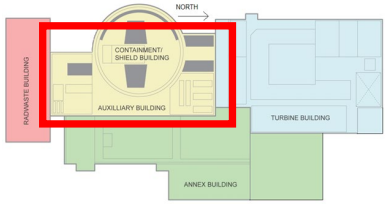
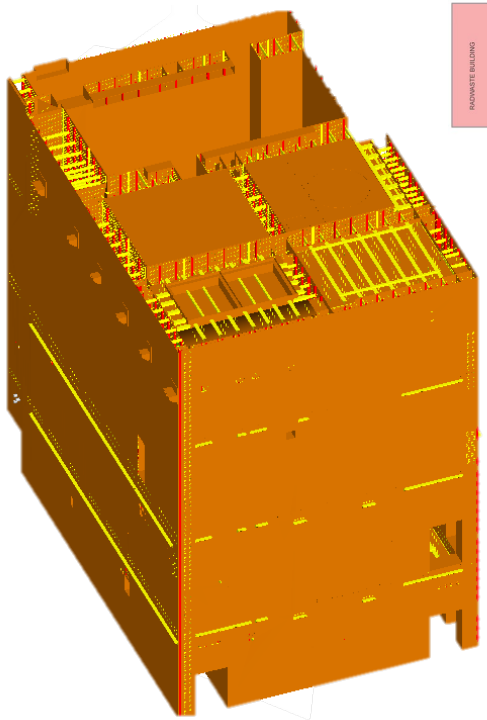
Safety-Related Steel Structures

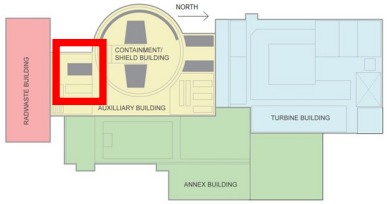


Auxiliary Building

- Roof Structural Steel

Safety-Related Steel Structures

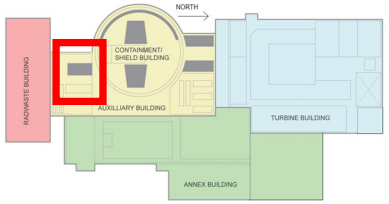




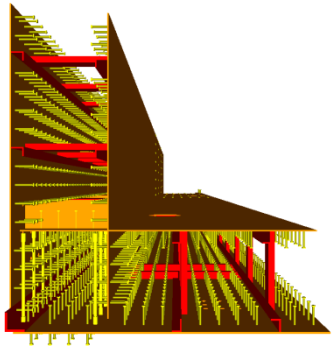
Auxiliary Building – CA20 Module – Aux Areas 5 & 6

- 72 pre-fabricated submodules
  - Carbon Steel and Duplex Stainless Steel
  - Max submodule size: T=3.20m x W=3.66m x L=21.03m
  - Max plate size: T=19.1mm W=3.6m L=14.0m
  - Max submodule weight ~ 47.5 t
- Assembled (on site) Size (L x W x Height): 20.5 x 14.2 x 21 m
- Assembled (on site) Lift Weight: 905 t

Safety-Related Steel Structures

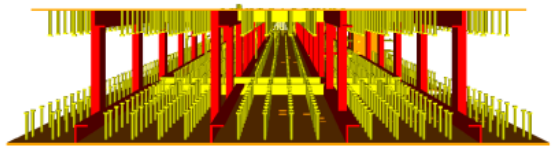


Auxiliary Building – CA20 Submodule Configurations



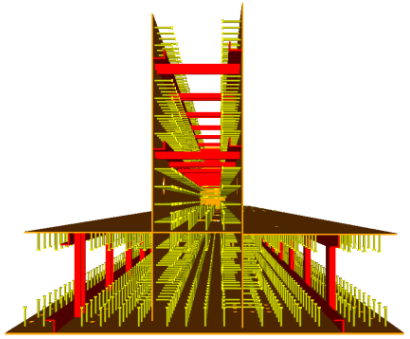
L-Shapes

8 Sub-Modules



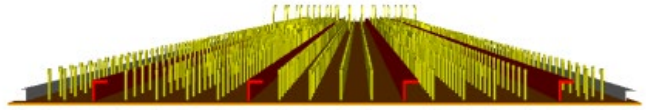
Flat Panels

17 Sub-Modules



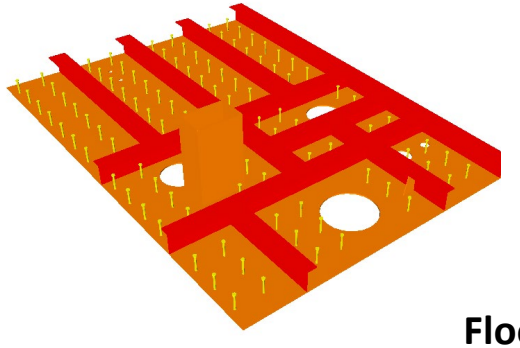
T-Shapes

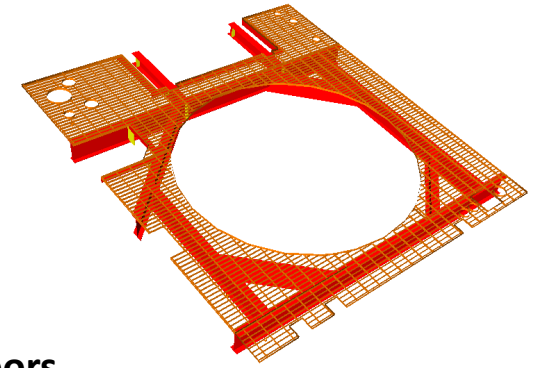
3 Sub-Modules



Single Panel

4 Sub-Modules





Floors

40 Sub-Modules

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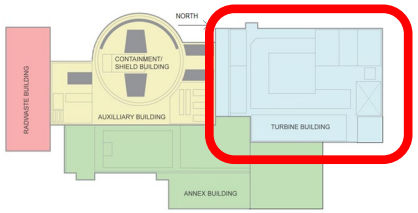
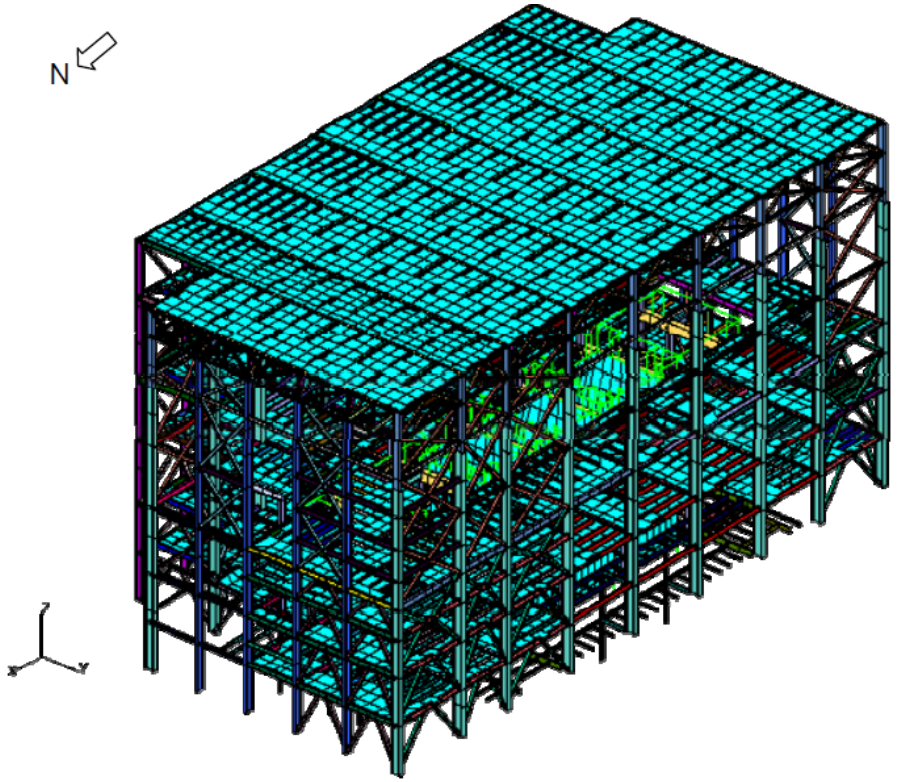
Non-Safety-Related Steel Structures

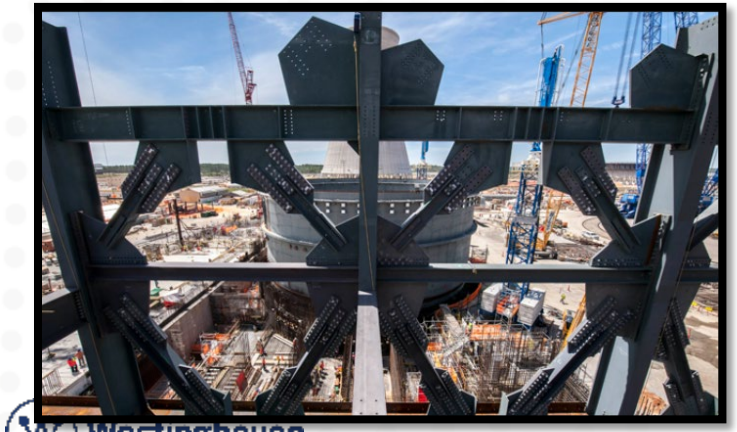


Turbine Building

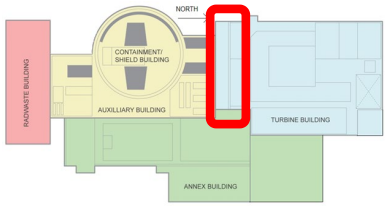
- The Turbine Building is adjacent to the nuclear island structures on the north side
- Consists of two separate superstructures on a shared reinforced concrete slab.
- TB Main Area
  - Non-Safety-Related Structure (Safety Class E)
  - Non-Seismic (Seismic Category III)
  - Braced steel column and beam structure, with reinforced concrete and steel grated floors.
  - Designed with eccentrically braced framing (EBF).

Total Weight: ~10,953 t





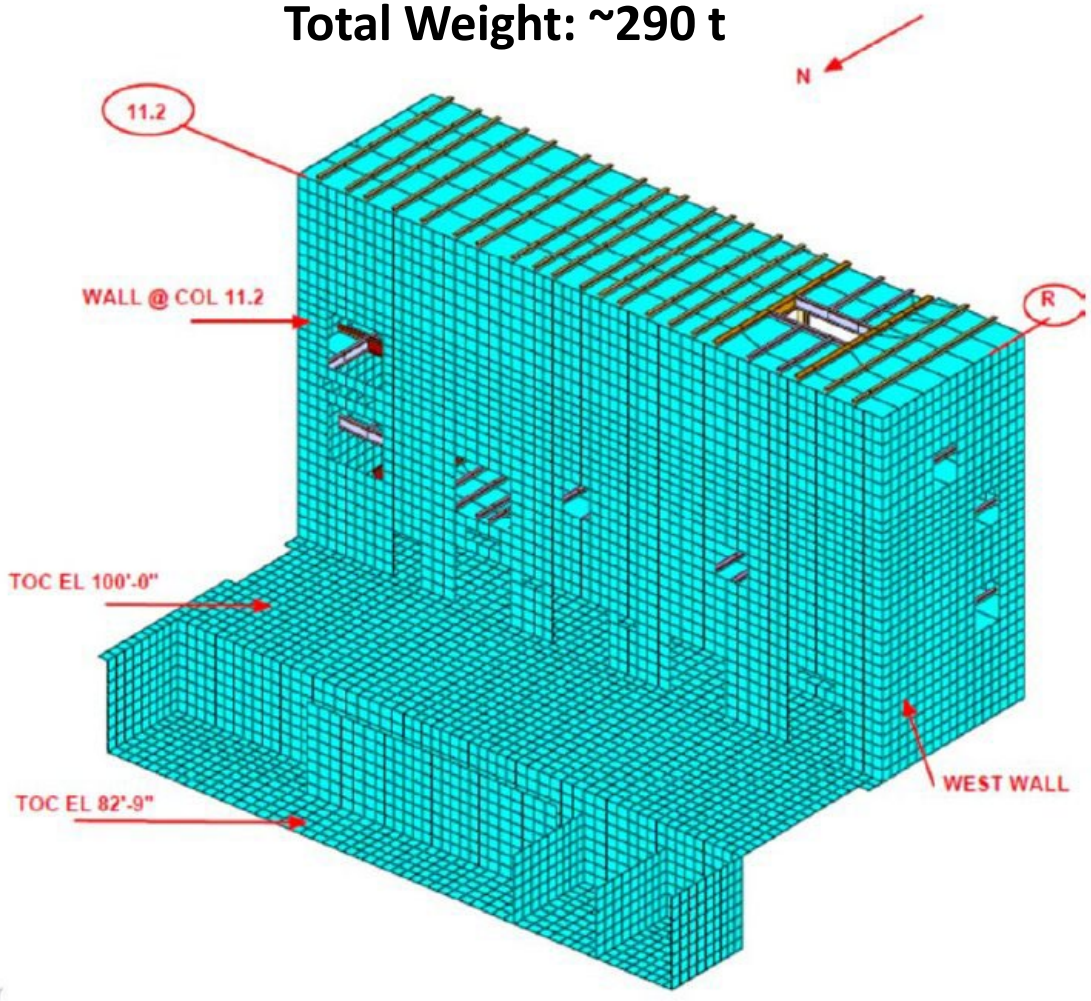
Non-Safety-Related Steel Structures



Turbine Building

- First Bay
  - Immediately Adjacent to the auxiliary building.
  - Non-Safety-Related, Safety Class D (Augmented Quality).
  - Seismic Category II structure due to immediate proximity to the auxiliary building.
  - Combination of reinforced concrete walls and steel framing with reinforced concrete and steel grated floors.
  - Designed to the same codes and standards as the NI structures.
  - Similar materials as the NI structures.
  - **Total structural steel weight: ~ 290 t**

Total Weight: ~290 t



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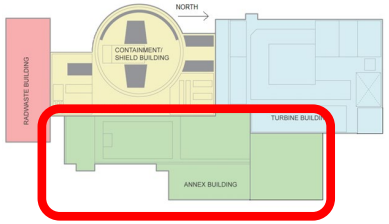
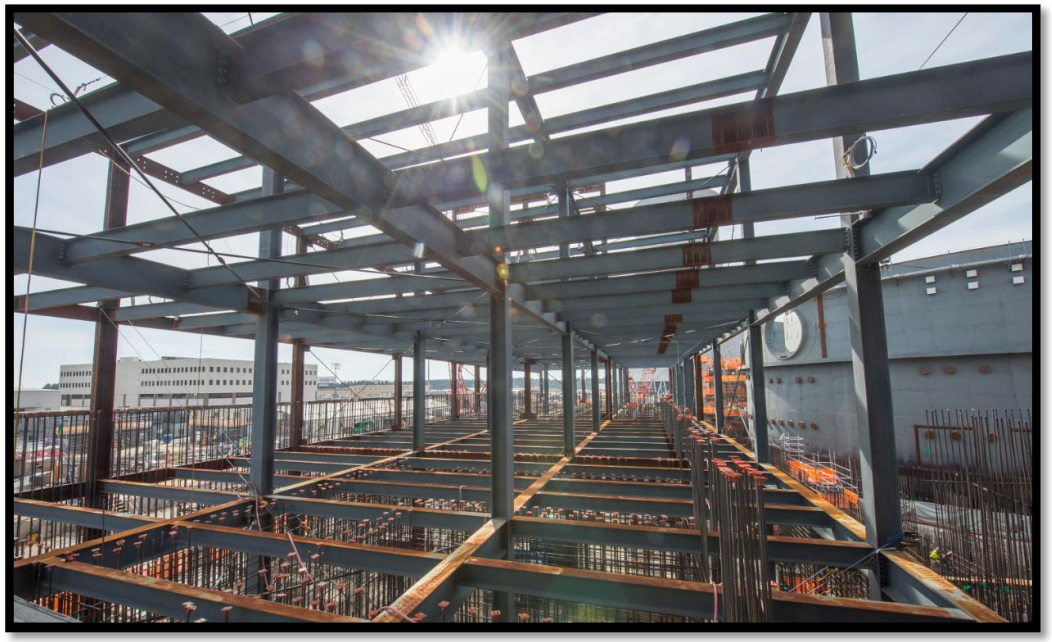
Non-Safety-Related Steel Structures



Annex Building

- The Annex Building is adjacent to the Nuclear Island structures on the east side.
- Includes facilities for segregated storage of various categories of waste.
- Safety Class and Seismic Category varies:
  - Non-Safety-Related, Augmented Quality (Class D); Seismic Category II
  - Non-Safety-Related (Class E); Non-Seismic (Seismic Category III)
- **Total weight: ~1398 t**



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Thank You

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To access the site either visit the site link:
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or scan the QR code below with any device with an internet connection

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